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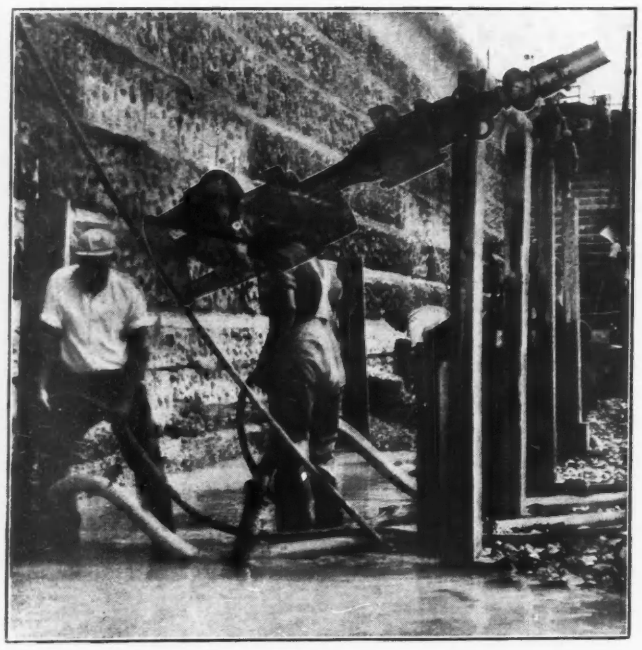

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A Seven-Day Journal

The Institution of Electrical Engineers.

SPEAKING at the annual dinner of the Institution of Electrical Engineers, held at Grosvenor House on Thursday, February 7th, the President, Professor W. M. Thornton, said that the Institution had many ideas submitted to it in the form of papers. But the essential vitamins of the profession were the new ideas of pure science ; the fresh facts or laws that were discovered by physical research or in the borderland between physics and engineering. It was one of the causes of pride in our race that every fifty years or so vitalising discoveries had been made. Men of supreme genius, such as Newton, Faraday, Maxwell, and Rutherford, had started new epochs in science. The secret of the country's ability to lead the way in the field of discovery was to be found in a capacity for intense and prolonged thought and work, profound logical common sense, a power of associating facts and ideas, and an acute sense of the trail. The great technical societies, such as the Institution of Electrical Engineers, were the modern counterpart of the mediæval guilds, to which England owed so much. They were chiefly concerned with the maintenance of a good standard of work, with the education of apprentices, and with the help of members in distress. By the reading of scientific and technical papers, and the supervision of wiring regulations the first aim was met by the Institution. In co-operation with the Board of Education the Institution examined about 3000 students a year, and its Benevolent Fund was always in action. To deal with urgent cases it was desired to increase that fund, and it was hoped that there would be a generous response to the appeal recently issued for more subscribing members, even if the amount in each case was small. One of the most interesting events of the session had been the establishment of a transmission section, and another section or sub-section was needed to cover electro-acoustics.

Tramp Shipping Organisation.

ON Thursday, February 7th, it was announced by the Chamber of Shipping of the United Kingdom that a Tramp Shipping Advisory Committee had been constituted to deal with organisation and co-operation within the industry, and so to comply with one of the conditions desired by the Government in connection with its subsidy offered to tramp shipping. The Committee consists of twelve members elected by the Tramp Shipowners' Committee, and three elected by the Joint Liner Committee of the Chamber and the Liverpool Steam Shipowners' Association. Its members are Sir F. Vernon Thomson, the Chairman, London ; Mr. Charles Alexander, London ; Sir Alfred Booth, Liverpool ; Mr. G. P. Christopher, London ; Mr. D. L. C. Crombie, Glasgow ; Mr. R. I. Dodsworth, London ; Mr. Philip Haldin, London ; Mr. L. C. Harris, London ; Mr. John Niven, London ; Colonel L. Ropner, West Hartlepool ; Mr. Philip Runciman, London ; Mr. Willie Reardon-Smith, Cardiff ; Mr. W. A. Souter, Newcastle-on-Tyne ; Mr. R. March K. Turnbull, London ; and Mr. E. H. Watts, London. The Committee will endeavour to promote the fuller employment of the British shipping and seafaring classes, to co-ordinate the operations of tramp owners, and to promote co-operation between tramp and cargo liner owners in order to minimise "domestic competition." It will also, where possible, co-operate with other shipowners' organisations such as the International Shipping Conference. The Committee will also co-operate with the Subsidising Advisory Committee in securing the objects of the subsidy and the conditions on which it is granted.

The London Power Company, Ltd.

SOME interesting particulars with regard to the working of the London Power Company's undertaking were given by Sir Francis Fladgate in his chairman's address at the annual general meeting of the company, which took place in London on Friday, February 8th. There was no doubt, Sir Francis said, that the linking up of generating stations had brought an increase in the reliability of supply and improved efficiency in operation. When the company began its operations in 1926 the average total cost per unit to the constituent companies was 0·983d. per unit, while for the year 1933 that cost had fallen to 0·5195d. per unit. The greater portion of the saving had been handed on to the consumers. The combined efforts of the officials of the Central Electricity Board and the staff of the London Power Company, Ltd., would, he thought, in time succeed in finding a solution to the many technical problems incidental to a scheme of such magnitude and complexity. On the financial side, there was still much to be done before the company received equitable treatment, and Sir Francis said that nothing short of an amendment to the 1926 Act would ease the situation. Speaking of the company's generating stations and their operation, he said that they were amongst the most efficient in the country, that they were adequately staffed, and that nothing was left undone to maintain their efficiency at the highest possible level. The output of the Battersea station had exceeded that of any other station of the company, and the two generating plants had been in regular service throughout the past year. The station had now attained a thermal efficiency of slightly over 28 per cent., and he was advised that even better results might shortly be anticipated. With regard to breakdowns, the London Power Company, Ltd., had during the past twelve months on seven different occasions been able to render assistance through the Central Electricity Board to various undertakers in the south-east area by taking loads at very short notice, ranging from 8000 kW to 25,000 kW, and thus preventing what might otherwise have been serious complications and interruptions to supply.

The Unemployment Figures.

ACCORDING to a statement issued by the Ministry of Labour on Monday, February 11th, it is estimated that on January 28th there were approximately 10,053,000 insured persons aged 16–64 in employment in Great Britain. This was 195,000 less than on December 17th last, but 175,000 more than on January 22nd, 1934. The official statement says that the decline in employment between December 17th and January 28th was most marked in those industries which ordinarily experience a seasonal setback in January, including the distributive trades, building and public works contracting, road transport, dock and harbour services, hotel and boarding-house services, and the printing and tailoring industries. In the building and the public works contracting industries the normal seasonal decline was accentuated by the effects of unfavourable weather conditions in many districts during January. There was also a decline in the cotton, woollen and worsted, and hosiery industries, in general engineering, and in the electrical apparatus and metal goods manufacturing trades. On January 28th, 1935, the numbers of unemployed persons on the registers of employment exchanges in Great Britain were 1,882,034 wholly unemployed, 353,994 temporarily stopped, and 89,345 normally in casual employment, making a total of 2,325,373. This was 239,558 more than the number on the registers at December 17th, 1934, and 63,695 less than a year before. The total on January 28th, 1935, comprised 1,820,758 men, 78,608 boys, 355,315 women, and 70,692 girls. It is further pointed out that the rise in unemployment as compared with December, which is normal at this time of the year, was accentuated not only owing to the spell of unfavourable weather already referred to, but by a large registration of juveniles who reached school-leaving age at the end of the December term.

Water Supplies.

ON Tuesday, February 12th, advance particulars were made known of the report of a joint conference of representatives of the Institution of Water Engineers, the British Waterworks Association, and the Water Companies Association on the national water supply question. The report of the conference favours, we understand, the setting up of a separate and specialised water department of the Ministry of Health, with regional advisory committees. It rejects the suggestion that the problem of water shortage in certain areas can be met by the establishment of a national water grid, and holds that such a system is totally unjustified, especially from the economic point of view. The suggestion that there should be a complete nationalisation of water supplies is emphatically rebutted. With regard to the problems to be solved in rural areas, these, it is pointed out, concern only a relatively small proportion of the population of England and Wales, and they are much more those of paving the way for the initiation of sound schemes and the financing of them, and of reconciling conflicting interests, than problems of an engineering nature. The idea of a special department of the Ministry of Health to deal with water problems is elaborated and the duties of such a department in relation to water undertakings defined. Attention is drawn to the fact that the consumption per head per day is increasing and must be provided for, which enhances the difficulty in many districts of finding suitable new sources of supply such as will prove sufficient and reliable in times of drought.

New Naval and Mercantile Orders.

THE Admiralty announces that, subject to the settlement of certain points of detail, it has decided to entrust the construction of the net layer for the 1934 programme, H.M.S. "Protector," to Yarrow and Co., Ltd., of Scotstoun, Glasgow. The vessel, we understand, will be larger and more powerful than the H.M.S. "Guardian," which has a displacement tonnage of about 3000 and geared turbine propelling machinery of approximately 6500 s.h.p., designed for a speed of 18 knots. In the "Guardian" there is a single boiler-room with three SX type Babcock boilers, but in the new ship there will be two boiler-rooms with four boilers of the standard Yarrow three-drum type. Among mercantile orders placed during the seven days under review is one for six decked barges placed by the Thames Steam Tug and Lighterage Company, Ltd., with Harland and Wolff, Ltd., of North Woolwich, and one for a 285ft., 50ft. wide motor ship for trading between Buenos Aires and Rosario, which has been placed with Henry Robb, Ltd., of Leith. The ship will be generally similar to the "Aquila," which was constructed for the same owners four years ago, and she will be propelled by a twin-screw arrangement of Atlas oil engines, totalling 1450 s.h.p. and designed for a speed of about 10 knots when loaded with 1500 tons on a draught of about 8ft. 6in. The Caledon Shipbuilding and Engineering Company, Ltd., of Dundee, is to build a small 175ft. motor coaster for the Dundee, Perth and London Shipping Company, Ltd., of Dundee.

An East Scotland Shipbuilding Fusion.

TOWARDS the end of last week it was officially announced that Henry Robb, Ltd., of Leith, had concluded arrangements for the purchase of the goodwill, plant, and buildings of Ramage and Ferguson, Ltd., of Leith, whose shipyard adjoins the Victoria Shipyard of Henry Robb, Ltd. The additional plant, which comprises five building berths and an engine works, will enable the new owners to develop their activities considerably. It may be recalled that the firm of Ramage and Ferguson, Ltd., was in business for close upon half a century and that during that time it constructed many naval vessels and also cargo and passenger steamers and yachts. It is the intention of the purchasers of the yard, we understand, to seek to bring back to Leith a share of Admiralty contracts, and to revive the yacht building industry, for which the Firth of Forth formerly enjoyed a high reputation. It is of interest to record the fact that Mr. Henry Robb, before founding the business which bears his name, was for nearly five years in charge of the shipyard of Ramage and Ferguson, Ltd. He has played a pioneer part since 1918, and has specialised in the building of motor coasters and special ships, which have included two of the largest and fastest vessels in the British coasting trade, as well as electric and steam tugs and a special type of trawler for the Admiralty.

Battersea Power Station.

AT its meeting held on Tuesday, February 12th, the London County Council, under the chairmanship of Lord Snell, agreed with the report of its Housing and Public Health Committee that the consent of the Electricity Commissioners to the installation of three additional boiler units required to complete the existing boiler-house and the first half of the Battersea station of the London Power Company, Ltd., should only be given on conditions similar to those imposed in connection with the extension of the Fulham generating station in 1930. The Council is further of the opinion that such consent should be limited strictly to the three additional boiler units referred to, and that the local authorities should be notified of any proposed further extension of either generating or boiler plant at Battersea, and should be given an opportunity of making representations to the Electricity Commissioners. The report of the Committee, which was considered by the Council, deals fully with the history of Battersea station and the present application, and the measures which have been taken to avoid nuisance or menace to health. Reference is also made to the good report of the Government Chemist's Committee and the Port of London Authority's Chemist on the low percentage of sulphur fumes in the gases and the lack of acidity of the discharged washing water. This report was summarised in a Journal note of December 28th. The Committee also raises the question of the argument which is often adduced in favour of the erection of large power stations that they will enable small stations to be closed. It proposes to ask the Commissioners to furnish information as to the extent to which this counterbalancing factor has been brought into play up to the present, and is likely to operate as a result of the extension to the Battersea plant which is now proposed.

The American Airship Disaster.

WE have to record with regret the total loss of the American Navy Airship "Macon," which, while returning with the Pacific fleet from Los Angeles to San Francisco on Tuesday evening, met with disaster and sank in about 50 fathoms of water off Point Sur, California. According to her commander, Lieut.-Commander H. Wiley, a stern casualty occurred at 17.18 Pacific time, or 1.18 a.m. Greenwich Mean Time, while the ship was proceeding north off Point Sur at a speed of about 63 knots and an altitude of 1250ft. in squally weather. The ship took a bow inclination and started to rise rapidly. The ballast and fuel were slipped, and all tanks dropped aft of 'midships, but both No. 1 and 2 gas cells gave way and the stern crumpled up. The ship landed stern first with no way on, and all hands took to the rubber boats. With the exception of two of the crew, the full complement of the ship—twenty officers and sixty-three men—were all rescued by cruisers, destroyers and coastguard vessels. The "Macon" was completed in the spring of 1933, and was almost identical with the "Akron," which was lost at sea in April of that year. The main particulars of these ships were : Length, 785ft.; diameter, 133ft., with eight Maybach petrol engines totalling 4500 s.h.p., giving a cruising speed of about 65 miles per hour, and a maximum speed of 82 miles per hour. The total capacity for helium gas was about 6,850,000 cubic feet. A description of the "Akron" will be found in our issue of January 8th, 1932.

SOME EARLY PARSONS INDUSTRIAL TURBO MACHINERY

(For description see opposite page.)

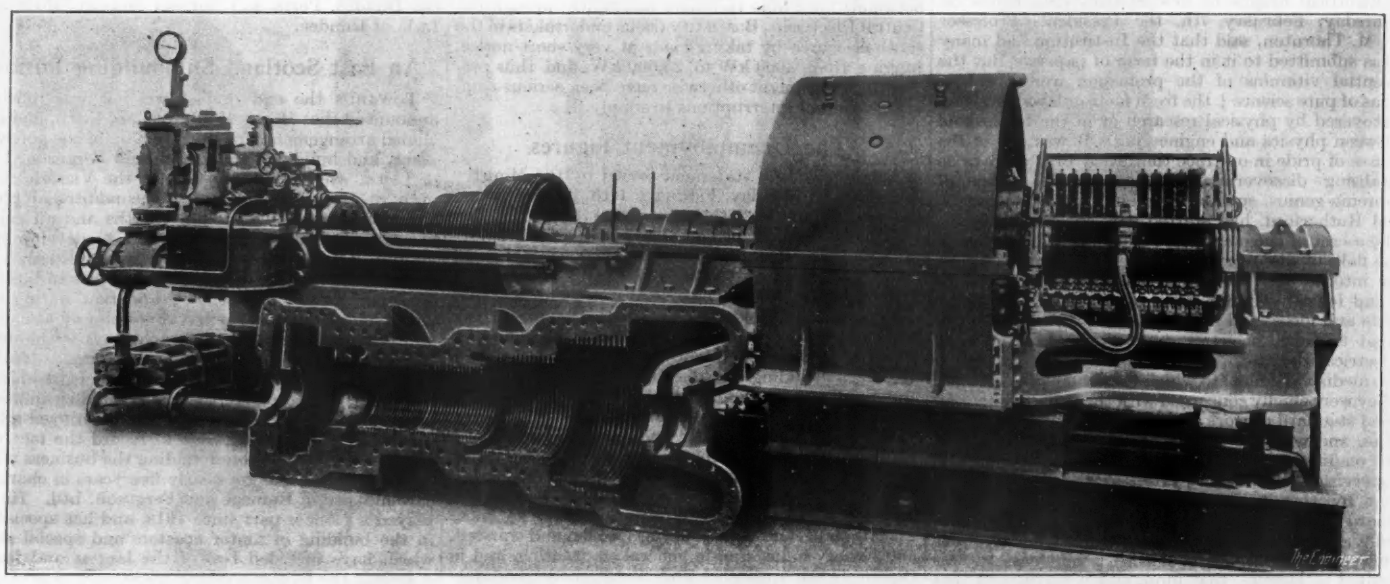


FIG. 55—ONE OF THE 375-KW TURBO-GENERATORS FOR THE "LUSITANIA" AND "MAURETANIA"—1905

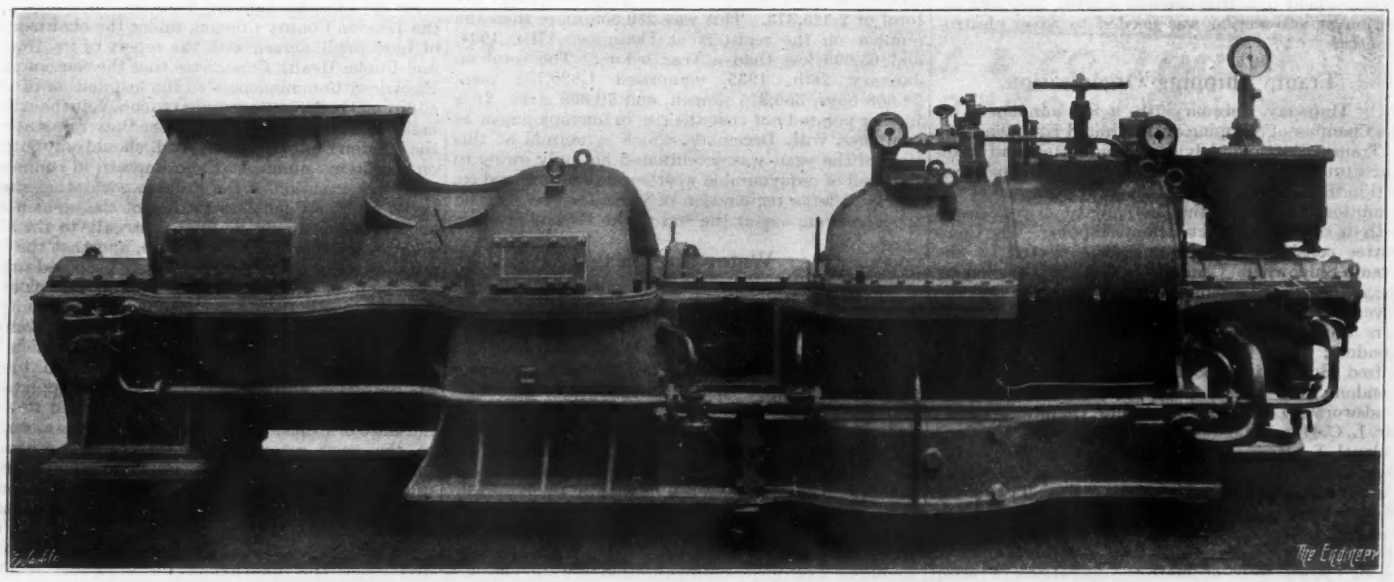


FIG. 56—EXHAUST STEAM TURBO-BLOWER FOR STAFFORD COAL AND IRON COMPANY, LTD.—1906

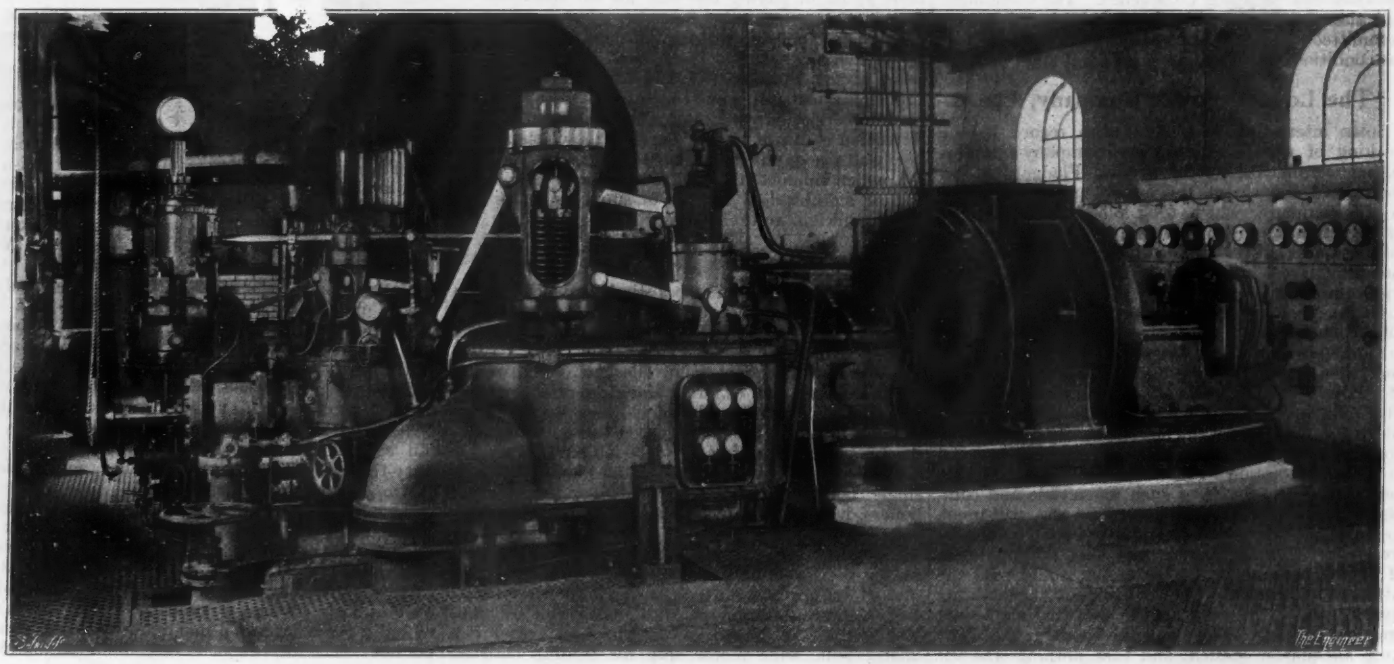


FIG. 57—750-KW MIXED PRESSURE TURBO-GENERATOR AT NINE MILE POINT COLLIERY—1908

The Development of Parsons Industrial Turbo Machinery.

No. VI.

(*Continued from page 143, February 8th.*)

TURBO-GENERATORS FOR THE "LUSITANIA" AND "MAURETANIA."

TURBO-GENERATORS for ship lighting are so much more akin to industrial than to central station machinery that certain examples may properly be referred to in this series of articles. Most of the early turbo-generators were built for ship lighting, the list commencing with a unit of 2-kW installed on the "Earl Percy" in 1885. The nature of the work mostly calls for quite small machines, and up to the year 1905 no set of greater capacity than 110-kW had been built for service on shipboard. In that year Messrs. Parsons put in hand the construction of a turbo-dynamo of 375-kW capacity for the approval of the Cunard Steamship Company, who desired to have continuous-current sets for the lighting of the Atlantic liners "Lusitania" and "Mauretania." The machine met all the requirements of the company, which accepted it, and gave the order for seven more similar units. Of these eight sets, four were placed in each vessel, two on the port side and two on the starboard side.

Fig. 55 shows the appearance of one of these sets before despatch from the Heaton Works. The top half of the cylinder has been removed to show the arrangement of the blading. Each machine developed 375 kW at 110 volts, when running at 1200 r.p.m., and exhausting either into a condenser or against a back pressure of 5 lb. above atmospheric pressure. The latter was the normal condition of operation, the exhaust steam from the turbine being used for heating the boiler feed water. When the vessels were in port the steam was not required for this purpose, and the turbine exhausted into its condenser.

Reference to the general arrangement illustrated in Fig. 58 will show several changes from previous practice, as regards the governor and the stop valve. In the turbine built for Messrs. Guinness, illustrated in Fig. 47 (*ante*), and in several machines that followed it, the governors had been placed in the bottom half of the steam end of the cylinder, and a combined runaway and stop valve had been employed. In the sets built for the Cunard Company it will be seen that the governor was replaced in its earlier position on top of the steam end pedestal, but was now completely enclosed. The reason for the reversion to the old position was the difficulty sometimes experienced in adjusting the axial position of the turbine shaft on account of the resistance of the gear. Although the lower position of the governor was undoubtedly an advantage from the point of view of the quantity of material to be dismantled before the turbine could be opened up for inspection of the rotor, it was considered that this was outweighed by the greater operating convenience of the alternative arrangement. It was also found that most engineers of those days preferred the stop valve to be entirely separate from the runaway valve, so that the combination of the two valves was discontinued.

The generators were of the usual construction for continuous current turbo machines of the period. They were provided with compensating windings to prevent sparking, and their current was collected by brushes of brass wire in gravity loaded brush holders.

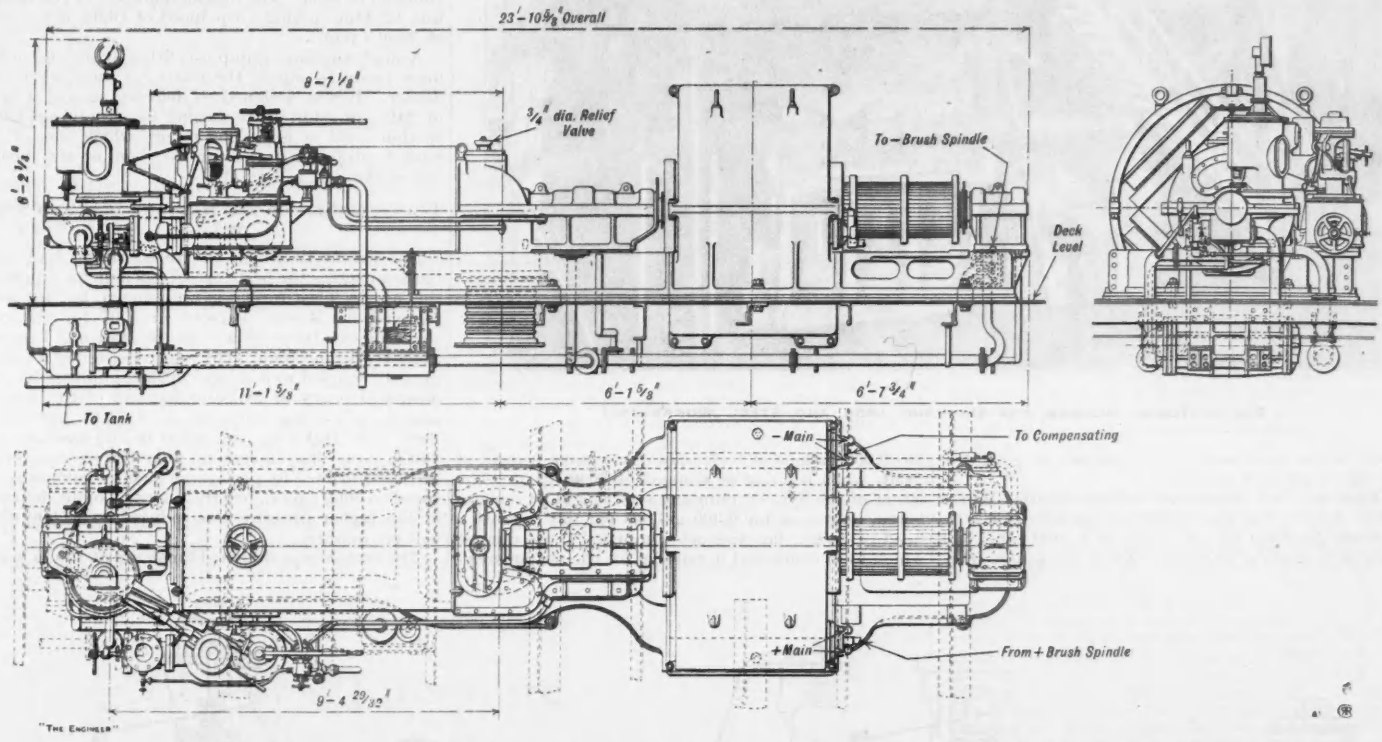


FIG. 58—GENERAL ARRANGEMENT OF 375-KW TURBO-GENERATORS FOR "LUSITANIA" AND "MAURETANIA"—1905

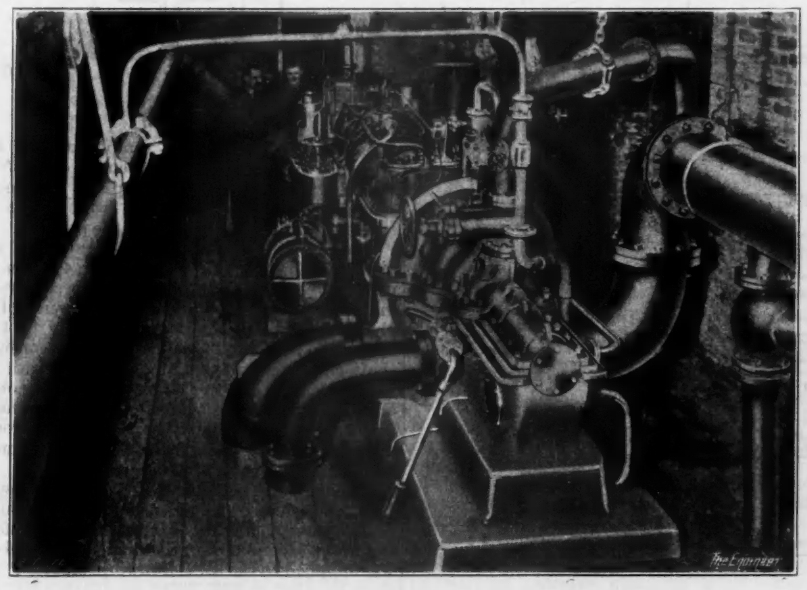


FIG. 59—TURBINE DRIVEN PUMP AT PRESTONPANS PIT—1907

EXHAUST STEAM TURBO-BLOWER FOR BLAST-FURNACE WORK.

By the year 1906 it was becoming recognised that a reciprocating engine exhausting to atmosphere was only utilising about half the energy available in the steam, and that the greater part of the loss might, as had been pointed out by Sir Charles Parsons in 1894, be recovered by the use of an exhaust steam turbine working in conjunction with the engine. Among the first of the firms to take advantage of the principle was the Stafford Coal and Iron Company, Ltd., who, in 1906, ordered a turbo-blower from Messrs. Parsons, the turbine to work with exhaust steam from existing reciprocating machinery and the blower to supply air for blast-furnace purposes. A photograph of the unit supplied is reproduced in Fig. 56. It was designed to deliver 14,000 cubic feet of free air per minute at a pressure of 6 lb. or 8 lb. per square inch when running at 3000 r.p.m. The blower was similar in construction to the blower supplied to Sir B. Samuelson and Co., Ltd., in 1903, and illustrated in Fig. 45 (*ante*). The turbine rotor had a uniform diameter of 18in., and carried fourteen rows of running blades, increasing in height from 1·375in. at the steam inlet to 4·5in. at the exhaust. The arrangement of the governor and the design of the valve gear followed

FIG. 60—"PRESTONPANS" PUMP WITH COVER REMOVED

the practice adopted in the 375-kW ship-lighting units built for the Cunard liners "Lusitania" and "Mauretania," and illustrated in Figs. 55 and 58 above. A hand-operated overload valve enabled live steam to be admitted to an intermediate stage of the turbine when it was required to increase the speed of the machine for the purpose of getting a specially high blast pressure.

When the unit was tested at the Heaton Works before delivery, it was found to consume 14,600 lb. of steam per hour for an output of 14,000 cubic feet of air per minute at a pressure of 6 lb. per square inch.

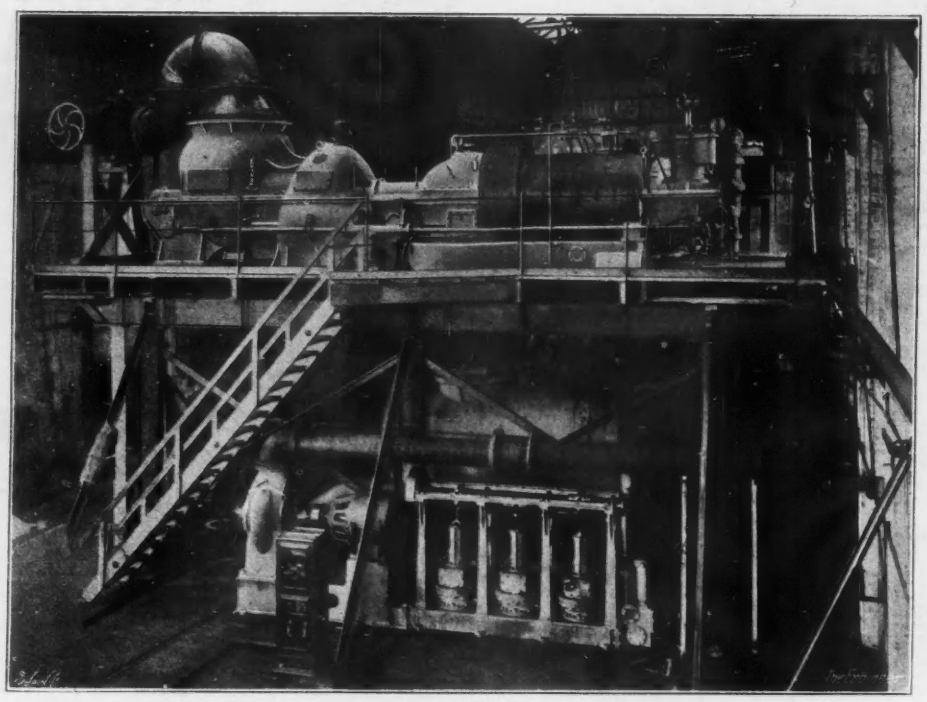


FIG. 61—TURBO-BLOWER FOR HANYANG IRON AND STEEL WORKS—1907

TURBO PUMP FOR PRESTONPANS COLLIERY.

The two turbo pumps constructed for the Sydney Waterworks in 1902 held the record for size of turbine driven pumps until 1907, when a pumping unit of considerably greater power was built for the Edinburgh Collieries, Ltd. It was installed at the bottom of the company's Prestonpans Pit for the purpose of raising the drainage water to ground level. A photograph of the plant in position at the pit bottom is reproduced in Fig. 59. Its duty was to deliver 3,600,000 gallons of water per day against a head of 283ft. when running at a speed of 3000 r.p.m. The larger of the Sydney pumping sets, it will be remembered, delivered 4,500,000 gallons per day against a head of 240ft., but this set comprised three pumps, which were connected in parallel for the output mentioned. Each of the individual pumps delivered only 1,500,000 gallons per day against 240ft. head, and it is with these figures that the duty of the Prestonpans unit should be compared.

About 215 water horse-power had to be developed by the pump at normal load, and to drive it a turbine rated at 288 kW at 3000 r.p.m. was employed. The turbine was designed to work with saturated steam at a pressure of 80 lb. per square inch at the stop valve, and to exhaust into a vacuum of 27in. provided by a condenser of the ejector type. It contained fifty-eight pairs of blade rows, ranging in height from 0·625in. on a diameter of 8·25in., up to 4in. on a diameter of 16in. The steam chest was mounted separately from the turbine cylinder and was situated alongside the latter. It was of what has become known as the "three-pot" design, the name being derived from the three valve bodies provided in the casting for the runaway valve, the governor valve and the overload valve respectively. In this particular machine, however, the main governor valve was omitted, as automatic speed regulation of the pump was not required.

The pump was constructed on the lines adopted for the large Sydney unit. Water entered it from each end and was discharged at the centre. To assist the flow of the water into the eyes of the runner a bladed propeller was mounted on the shaft on either side of the runner. Fig. 60 shows the appearance of the pump with the cover removed to allow the position of the runner and the arrangement of the diffuser vanes to be seen. The overall diameter of the runner was 12·44in., giving a tip speed of 163ft. per second at 3000 r.p.m.

A small auxiliary pump was fitted at the end of the main pump to supply the water for the ejector condenser. It was designed to delivery against a head of 24ft., in addition to raising its supply against a suction head of 6ft. The pump, which was of the bladed propeller type, can be seen at the nearer end of the unit in Fig. 59.

TURBO-BLOWER FOR THE HANYANG IRON AND STEEL WORKS.

The extent to which the turbo-blower had established itself as the best type of machine for supplying the air to blast-furnaces was shown by an order received by Messrs. Parsons in 1907 for the construction of a turbo-blower for the Hanyang Iron and Steel Works in China. The unit consisted of a blower directly coupled to a steam turbine, and capable of a normal delivery of 28,240 cubic feet of free air per minute at a gauge pressure of 11·75 lb. per square inch. For this duty the speed of the machine was 2400 r.p.m. For emergency duty the pressure could be raised to 14·7 lb. per square inch by increasing the speed to 3000 r.p.m., but the quantity of air delivered at the higher pressure was reduced to 22,000 cubic feet per minute.

The turbine was designed for steam at 135 lb. gauge pressure superheated to a temperature of 458 deg. Fah. It exhausted into a vacuum of 27·5in., produced by a surface condensing plant. The governing arrangements of the turbine were those usually employed for steam turbines of the period.

The blower contained thirty-eight pairs of blade rows, diminishing in height from 4·125in. at the inlet to 3·375in. at the outlet. It was very similar in design and construction to the blower built for the Mount Morgan Gold Mining Company in 1904 and illustrated in Fig. 52 (*ante*). The rotor consisted of a shaft carrying thirty-eight discs, each with a single row of blading, and five larger discs which constituted a dummy piston for balancing the end thrust. The bladed discs were all of the same dimensions, their external diameter being 29in., while the dummy piston discs had a diameter of 37in.

The complete machine, erected on the test beds at Heaton, with its own condensing plant and auxiliaries, is illustrated in Fig. 61. It gave such satisfaction in use that a second unit of the same design and capacity was supplied to the same ironworks in 1910.

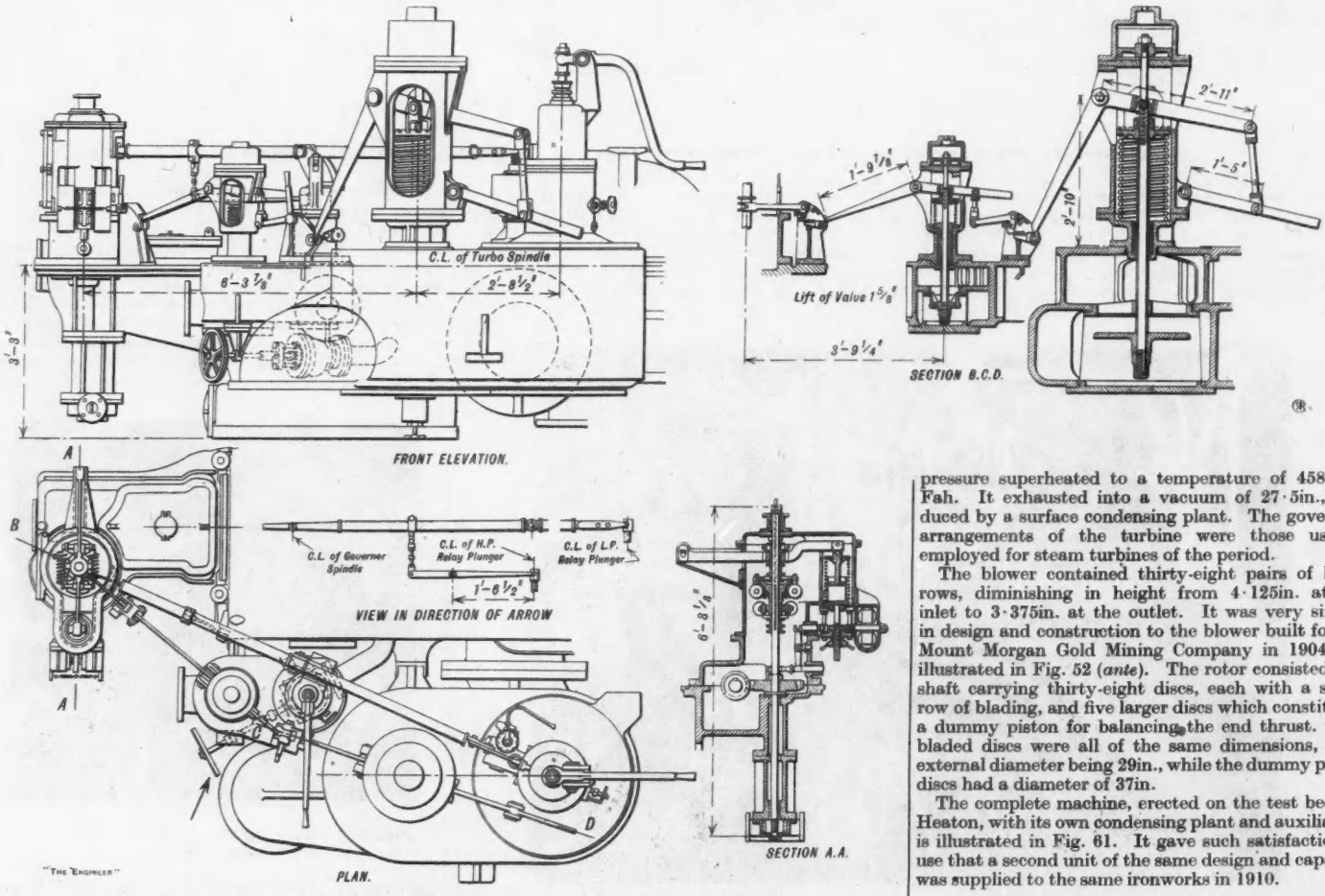


FIG. 62—GOVERNOR AND VALVE MECHANISM OF MIXED PRESSURE TURBINE

During the test the turbine was supplied with saturated steam at a gauge pressure of 3 lb. per square inch and exhausted into a 28in. vacuum.

MIXED-PRESSURE TURBO-ALTERNATOR FOR COLLIERY SERVICE.

The simple exhaust steam turbine, developing power from steam already expanded down to about the pressure of the atmosphere in a reciprocating engine, could obviously only operate at full capacity when the engine was also running at full load. A demand, therefore, arose for a type of turbine, the output of which should be relatively independent

of the supply of exhaust steam, although able to utilise to the full all of such steam as might be available at any time. It was consequently necessary to devise a machine which would automatically supplement any deficiency in the exhaust steam by the admission of sufficient live steam to carry the balance of the load required, the live steam, of course, being usefully expanded through its full range in the turbine and not merely throttled down before admission. Machines of this kind, known as "mixed-pressure turbines," were constructed at Heaton in the year 1907, for outputs of 500 kW and 600 kW respectively. In the following year a larger mixed-pressure unit, rated at 750 kW, was supplied to the order of Burnyeat Brown and Co., Ltd., of Monmouth, for service in conjunction with the winding engines at their Nine Mile Point Colliery. This unit was designed to give an economical output of 750 kW when supplied either with live steam at a gauge pressure of 150 lb. per square inch, superheated to 516 deg. Fah., or with exhaust steam from the winding engines at an absolute pressure of 17 lb. per square inch. A hand-operated by-pass valve in the live steam supply enabled a maximum load of 1125 kW to be carried when the turbine was exhausting to the condenser, or a load of 750 kW when exhausting to the atmosphere. The set ran at 1500 r.p.m. and generated three-phase current at 2200 volts and 25 cycles.

The turbine was provided with two separate steam chests, one for controlling the admission of live steam, and the other for that of the exhaust steam. These two steam chests can be clearly seen in Fig. 57, which shows the completely erected machine at the colliery. Each steam chest contained its own runaway valve and throttle valve. The speed governor controlled both the throttle valves, opening first the low-pressure valve and then the high-pressure valve, and closing them in the reverse order, while the emergency governor brought about the tripping of both the runaway valves simultaneously in case of overspeed.

The governor and valve mechanism is illustrated in Fig. 62. From the sectional drawing it will be seen that the runaway valves were closed upwards against their seats, each by its own spring, when the lever system was tripped either by the emergency governor or by the hand levers shown. A dashpot at the upper end of each valve spindle prevented shocks on the valves and seatings.

The speed governor and the runaway governor were mounted on the same spindle, but independently of each other. The sleeve of the speed governor was connected to the end of a long relay lever carried by a fulcrum bracket at the centre of its length. The relay plunger controlling the low-pressure throttle valve was operated directly by the far end of the relay lever, while the relay plunger of the high-pressure throttle valve was actuated by a subsidiary lever linked to the main relay lever at an intermediate point. If the load on the turbine increased the slight drop in speed caused both relay plungers to be moved to lower positions. The low-pressure plunger then restricted the escape of steam from beneath the relay piston with the consequence that the exhaust steam throttle valve was opened wider. The high-pressure plunger was so adjusted that the motion it received from the governor did not at first affect the high-pressure throttle valve. If the exhaust steam supply was not sufficient to cope with the load so that the speed continued to drop, the high-pressure plunger became operative, restricting the escape of steam from its relay cylinder and so opening the high-pressure throttle valve.

It will be observed that very close governing was hardly possible automatically as an appreciable speed range was necessary to cause the turbine to change over from exhaust to high-pressure steam. The governor, however, was fitted with an electrically operated speed-regulating device by means of which the speed of the turbine could be controlled from the switchboard. The mechanism employed for the purpose was as follows. The hand-operated screwed sleeve, by the rotation of which the tension of the governor-regulating spring was varied, carried a ratchet wheel. Surrounding this wheel was a ring carrying an internal pawl on each side, so arranged that only one pawl could engage with the ratchet wheel at a time. This ring was kept in continuous reciprocating motion in the plane of the wheel by means of an excentric on the governor spindle. An armature of soft iron, fixed to the ring, was normally held centrally between the poles of two electric magnets by tension springs. If either of the magnets was excited, the armature, and consequently the ring, was pulled to one side, with the result that the corresponding pawl was brought into engagement with the ratchet wheel. The latter was therefore caused to rotate by the reciprocating motion of the ring, increasing or decreasing the tension of the regulating spring according to which of the magnets was attracting the armature. Except during the times when one of the magnets was excited, the ring reciprocated in a central position and neither of the ratchets was in engagement.

(To be continued.)

Literature.

Thermionic Emission. By ARNOLD L. REIMANN, B.Sc., Ph.D., F. Inst. P. Pp. xi+324. London: Chapman and Hall, Ltd. Price 21s. net.

THE subject of the emission of electrons from hot bodies is one which, in these days, has a very practical application in connection with valve manufacture. The time was ripe for a critical presentation of the subject as it stands to-day, and, in this book, Dr. Reimann gives just such an account. Not only are the facts of a complicated subject clearly detailed, but the theoretical side of the subject also is treated in an admirable manner. It is no easy matter to discuss the applications of modern physical theory without producing a book much of which will be unintelligible, except to those who are well versed in the recent developments of mathematical physics. Dr. Reimann has succeeded in steering a middle course by giving merely the general argument when the details involve complex mathematical treatment. The excellent bibliographies attached to the various chapters will enable the reader to fill up any gaps should he desire to do so.

The various sections include a general survey of the subject, a discussion of the electron emission from hot metals and oxides, the modern theory of such phenomena, and finally, the emission of ions from electrolytes and metals. Such a book should supply a want to the ever-increasing number who are interested in the theory or in the practical applications of thermionics.

The Kingdom of the Camera. By T. THORNE BAKER, F. Inst. P., A.M.I.E.E., F.R.P.S. London: J. Bell and Sons. 1934. Price 18s. 6d.

MR. BAKER has long been one of the best-known authorities on technical photography. He has studied and carried out experimental work for many years on many of the lesser-known applications of the subject. Sir William Bragg, in his foreword to this book, observes: "What will surprise Mr. Baker's readers is the widespread variety of the applications of photography." This remark is undoubtedly true. Indeed, the various chapters introduce many interesting peeps into the technicalities of little-known specialised photography. The preparation of motion pictures, the principles of television, the preparation and production of the films of that supreme artist, "Micky Mouse"—all these things are explained by Mr. Baker in a very readable fashion.

Photography now plays an essential part in every-day activities, and the author describes its specialised use in such diverse matters as industry, medicine, crime, astronomy, and so on. In engineering, photography is becoming more and more a valuable method of investigation and research, and X-rays are now a recognised agent in inspection and development work, both in the detection of gross defects and in the analysis of fine structure of materials. Mr. Baker illustrates some of these applications, and in addition he tells us of the progress achieved in photographic recording instruments, as exemplified by such apparatus as the electro cardiograph, the seismograph, the Einthoven galvanometer, and astronomical telescopes.

The book is to be strongly recommended. Its subject matter is accurate, as we should expect from the author. On the other hand, it is eminently readable and is very interesting. Such purely technical details as are essential are fitted into the general scheme without impairing its value to the non-scientific reader. In fact, the book is obviously designed for such as he.

The Diffraction of X-rays and Electrons by Amorphous Solids, Liquids, and Gases. By J. T. RANDALL, M.Sc. Pp. xii+290. London: Chapman and Hall, Ltd. Price 21s. net.

WHILE many books have been published dealing with the diffraction of X-rays by crystalline solids, very few of them do more than make casual reference to the corresponding effects produced by amorphous solids, liquids, and gases. Admittedly, the X-ray diffraction patterns given by such substances are poor compared with those of truly crystalline materials; but they are capable of giving valuable information as to the structure of such bodies. In this book, Mr. Randall has collected the available data and has given a very clear account of the various theories which have been advanced to explain the phenomena observed. After a brief account of diffraction by crystals, the effect of diminishing crystal size on the pattern is discussed. This is followed by sections dealing with gases, liquids, and amorphous solids, such as glass and certain types of carbon. In these, both the experimental and theoretical aspects are fully discussed. The remaining chapters are devoted to the study of semi-crystalline materials, such as animal and vegetable fibres, and to the use of electron wave methods, particularly in the examination of surface phenomena. The book is well produced and excellently illustrated, and contains a vast amount of very useful information. Mr. Randall has rendered a real service by this critical survey of a subject which has up till now been somewhat neglected.

SHORT NOTICES.

Garcke's Manual of Electrical Undertakings and Directory of Officials. London: The Electrical Press, Ltd. Price 35s.—The 1934–35 edition of Garcke's Manual is the thirty-seventh annual volume. It covers the period which witnessed the completion of the grid as initially planned, as well as the beginning in certain areas of normal trading activities between the Central Electricity Board and various authorised undertakers, reflected naturally in the analysed accounts of the undertakings concerned. The volume contains, as usual, commercial and financial information, technical data, and operating statistics derived from reliable sources. The latest authentic information up to the time of going to Press is included, even to the extent of an "Addenda Section," providing summaries of the new accounts received while the volume was being printed. In the section covering the year's progress information is collated, analysed, and tabulated for comparison with the previous year, and contains on this occasion particulars relating to approximately 5200 undertakings associated with different branches of the electrical industry, including electricity supply, traction, telegraph and telephones, electrical manufacturing and allied companies, and colonial lighting power traction, and manufacturing concerns. The section also provides information concerning new parliamentary powers, electricity special orders, tramway, trolley vehicle and light railway orders, reports of Government Departments, Departmental Committees, and other official bodies connected with the industry. Some important new data are included for the first time, showing in respect of each undertaking the extent of the authorised area in acres, the population, number of premises in the area, and the rateable value. As a book of reference covering the fields mentioned, the volume stands alone, and, like its predecessors, should prove invaluable to many electrical men.

The Submarine Cable. By Captain S. A. Garnham and Robert L. Hadfield. London: Sampson Low, Marston and Co., Ltd. Price 10s. 6d.—Although, owing to the advances of wireless communication, the submarine cable is apt to be forgotten, it continues to render invaluable service to mankind and, as Sir Charles Bright says in a short introduction to this interesting volume, if ever this country is drawn into another war it will be our best friend. The story of the submarine cable from the time of its invention down to modern times is told by the authors in a clear and fascinating manner. Beginning with the first Atlantic cable, they go on to describe how such cables are laid and repaired, methods of deep-sea sounding, and cable ships. Chapters are also devoted to enemies of the cable, how the loaded cable works, cable ships in war, and the cable systems of the world. Written on popular lines, well illustrated and devoid of terms liable to puzzle non-technical readers, the book constitutes an interesting and useful addition to literature of the kind.

BOOKS RECEIVED.

The Motor Ship Reference Book for 1935. London: The Temple Press, Ltd., 5–15, Rosebery-avenue, E.C.4. Price 5s. net.

Logarithmic and Trigonometric Tables. London: Macmillan and Co., Ltd., St. Martin's-street, W.C. Price 1s. net.

Metallic Arc Welding. By H. Harris, Ph.D. London: Edward Arnold and Co., 41, Maddox-street, W.1. Price 16s. net.

"Mechanical World" Year Book, 1935. London: Emmott and Co., Ltd., 28, Bedford-street, W.C.2. Price 1s. 6d. net.

Rigbuilding. By R. C. Paget. London: Williams and Norgate, Ltd., 28–30, Little Russell-street, W.C.1. Price 10s. 6d. net.

Structural Design in Steel. By T. C. Shedd. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 25s. net.

The Superheterodyne Receiver. By A. T. Witts, A.M.I.E.E. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, W.C.2. Price 3s. 6d. net.

Government Experimentation in Business. By W. H. Persons, Ph.D. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C.2. Price 12s. 6d. net.

The Theory of Vibrations for Engineers. By E. B. Cole, M.Sc. London: Crosby Lockwood and Son, Ltd., Stationers' Hall-court, E.C.4. Price 15s. net.

Aircraft Progress and Development. By Captain P. H. Sumner. London: Crosby Lockwood and Son, Ltd., Stationers' Hall-court, E.C.4. Price 25s. net.

Report on the Treatment of Welded Structures by the Metallic Arc Process. London: Institution of Structural Engineers, 10, Upper Belgrave-street, S.W.1. Price 5s. net.

The Alloys of Iron and Copper. By J. L. Gregg and B. N. Daniloff. London: McGraw-Hill Publishing Company, Ltd., Aldwych House, Aldwych, W.C.2. Price 30s. net.

Brassey's Naval and Shipping Annual, 1935. Edited by Commander C. N. Robinson, R.N., and H. M. Ross. London: Wm. Clowes and Sons, Ltd., 94, Jermyn-street, S.W.1. Price 25s. net.

The Efficiency of Acme Screws and Nuts.

THE Acme thread screw and nut form a machine element on which very few data of friction loss are available. The most recent are by Ham and Ryan in University of Illinois Bulletin No. 247, previous to which the only other tests are by Kingsbury, and are more conveniently accessible for British readers in "Lubrication and Lubricants" (Archbutt and Deeley).

Among the many uses of this machine element—a "square" thread with sloping flanks—its arrangement as a means of raising and lowering the arm of a radial drilling machine furnishes an interesting example and also a convenient means of checking the coefficient of friction. The author in the following notes puts forward the results of several tests for

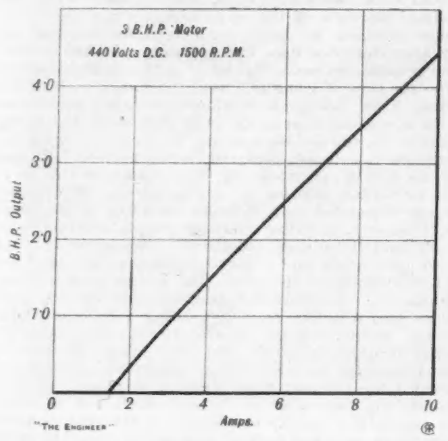


FIG. 1—CHARACTERISTIC OF ELECTRIC MOTOR

comparison with the authorities cited above, as he finds that the later series, first quoted, appear to be considerably lower than are usually obtained in practice.

The first example deals with the elevating screw of a 6ft. radial drilling machine, all readings being taken when the screw was warm.

Screw: 2in. dia., Acme thread, 0·333in. pitch, depth of thread 0·177in., mean diameter of thread 1·833in., length of nut, $5\frac{3}{4}$in.
Material of screw: Medium carbon steel (0·45 C), thread finished in lathe.
Material of nut: Chill cast phosphor bronze, thread cut by ground thread tap and nut honed on to screw.
Lubricant: Price's heavy cylinder oil (pure mineral.)
Thread angle = $\tan^{-1} 0{\cdot}05788 = 3° 18'$.
Area of thread = 17·55 square inches.
Net weight lifted + friction (see later) = 3590 lb.
Bearing pressure on threads = 205 lb. per square inch.
R.p.m. of screw = 1500 motor speed $\times \frac{14}{28} \times \frac{13}{61} = 160$ r.p.m.
Thread speed (mean) = 77ft. per minute.
Elevating motor, 3 h.p., 440 volts D.C., 1500 r.p.m.; input-output curve as Fig. 1.
Power to elevate = 4·9 ampères = 1·90 b.h.p.
Power to lower = 2·65 ampères = 0·70 b.h.p.

The arrangement of the drive and thrust support of the screw were as indicated in Fig. 2, and the loading due to the machine arm and saddle, as in Fig. 3.

The equivalent load lifted at the screw to correspond with the motor output, after allowing 0·3 per cent. loss in the thrust bearing and 2 per cent. in each of two gear pairs

$$= \frac{1{\cdot}90 \times 0{\cdot}957 \times 33{,}000}{4{\cdot}44} = 13{,}500 \text{ lb.}$$

Ditto lowering $= -4960$ lb. (negative as power is used to lower).

Thus $$\frac{\text{Tan } \theta}{\text{Tan } (\theta + \varphi)}$$

$$= \frac{\text{Total weight lifted} + \text{friction of arm on pillar}}{13{,}500}$$

$$\frac{\text{Tan } (\varphi - \theta)}{\text{Tan } \theta}$$

$$\frac{}{4960}$$

$$= \text{Total weight lowered} - \text{friction of arm on pillar}$$

From Fig. 3,

$$S = (17{\cdot}5 + 11{\cdot}5)\ 112 \pm 2\ F = 3248 \text{ lb.} \pm 2\ F$$

$$P = \frac{17{\cdot}5 \times 14{\cdot}75 + 11{\cdot}5 \times 36 - 5{\cdot}75\ S}{51}$$

$$= 1109 \text{ lb.} \mp 0{\cdot}226\ F$$

or $$P = 1109 \mp 0{\cdot}226\ \mu\ P = \frac{1109}{1 \pm 0{\cdot}226\ \mu} \text{ lb.}$$

The surface of the pillar was cast iron with ground finish and the mating portions of the rings in the arm were the same. The surfaces were greasy and the coefficient of friction has been taken as 0·16 (see "Lubrication and Lubricants," Table I, page 7), from which when the arm was elevated $P_E = 1070$ lb., $F_E = 171$ lb., and $S_E = 3590$ lb., and when the arm was lowered $P_L = 1151$ lb., $F_L = 184$ lb., and $S_L = 2880$ lb.

Thus

$$\frac{\text{Tan } (\varphi - \theta)}{\text{Tan } (\theta + \varphi)} = \frac{S_E \times 4900}{S_L \times 13{,}500} = 0{\cdot}4525.$$

Substituting tan $\theta = 0{\cdot}05788$, and solving, tan $\varphi = 0{\cdot}1591$.

As the sides of the Acme thread are inclined at $14\frac{1}{2}$ deg. to a radial line,

μ for screw and nut = tan φ cos $14\frac{1}{2}$ deg. = 0·154.

This value of the coefficient of friction for the nut and screw is the value at a thread speed of 77ft. per minute. The value of the static coefficient must also be considered, as it will be noticed from Fig. 2 that the screw was driven by a friction washer, which must be arranged to transmit the starting torque to start elevating the arm. To arrive at the value of the static coefficient a radius bar was fitted to the elevation motion in place of the motor, and the starting torque measured at the 13-tooth pinion was obtained, being 16·5ft. × lb. to start to elevate and 6·8 to commence lowering.

Treating these quantities as outlined above, and

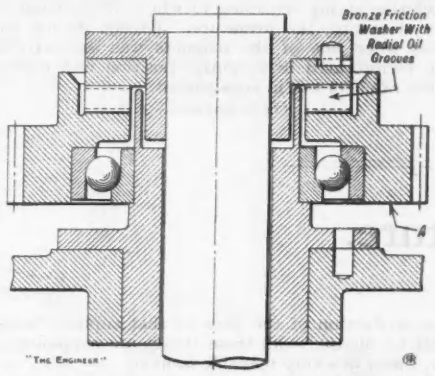


FIG. 2—DRIVE AND THRUST SUPPORT OF SCREW

taking the static coefficient of friction between pillar and arm as 0·21, the following results are obtained:—

Starting to elevate: $P_E = 1059$ lb., $F_E = 222$ lb.; $S_E = 3692$ lb.

Starting to lower: $P_L = 1164$ lb.; $F_L = 244$ lb.; $S_L = 2760$ lb.

and tan $\varphi = 0{\cdot}207$ and μ_s for nut and screw = 0·20.

The friction drive washer provided in the drive to

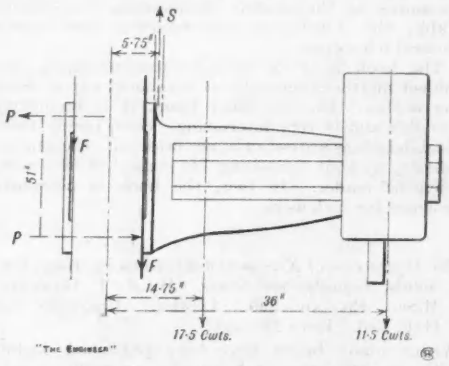


FIG. 3—MACHINE ARM AND SADDLE

the screw as a safety device at the limits of elevation and lowering consisted of a bronze annular washer, deeply guttered on both faces with radial grooves, lying between case-hardened and ground steel faces of the screw flange and driving gear. The dimensions were:—5·0in. O.D., 3·25in. I.D., mean diameter 4·125in., area of one face = 11·3 square inches.

The maximum pressure was $\frac{3692}{11{\cdot}3} = 327$ lb. per square inch at starting. Lubrication of the faces was by oil bath with mineral oil, and the faces of the bronze washer scraped and bedded to the mating hardened faces.

At the maximum torque transmitted, *i.e.*, $16{\cdot}5 \times \frac{61}{13} = 77{\cdot}3$ foot-pounds, the coefficient of static friction required at the collar was $\frac{77{\cdot}3 \times 12 \times 2}{4{\cdot}125 \times 3692} = 0{\cdot}122$, and under running conditions when elevating

$$= \frac{1{\cdot}90 \times 0{\cdot}957 \times 33{,}000 \times 2 \times 12}{2\ \pi \times 160 \times 4{\cdot}125 \times 3590} = 0{\cdot}097.$$

These two values are well within the safe limits, as when the friction drive was made to slip at the top limit of the arm travel the motor developed 2·33 b.h.p., giving a kinetic coefficient of friction at this washer of

$$\frac{2{\cdot}33 \times 33{,}000 \times 12 \times 2 \times 0{\cdot}957}{2\ \pi \times 160 \times 4{\cdot}125 \times 3692} = 0{\cdot}115.$$

The coefficient of static friction of this washer was probably 0·16.

TABLE I.—*Friction of Acme Thread Screws and Nuts—All Three Threads per Inch.*

1	2	3	4	5	6	7	Kinetic coeff. for washer in drive when slipping.	Remarks.
Machine.	Dia. of screw.	R.p.m. of screw.	Thread speed, ft./min.	Max. pressure on thread, lb./sq. in.	Coefficients of friction.			
					Kinetic.	Static.		
Radial drill	$1\frac{3}{4}$in.	149	61·3	219	0·165	—	0·112	
" "	$1\frac{3}{4}$in.	149	61·3	244	0·140	—	—	Machine three years old—nut and screw well bedded
" "	2in.	160	77	205	0·154	0·20	0·115	Normal result obtained in practice when new
" "	$2\frac{1}{4}$in.	149	81	269	0·174	—	—	Screw showing periodic errors
" "	$2\frac{3}{4}$in.	158	106	314	0·177	0·23	—	Ditto, ditto
" "	$3\frac{1}{4}$in.	104	83·6	286	0·152	—	—	

The above figures are summarised in Table I, which also contains data obtained in a like manner for several similar cases.

The comparative figures given by Kingsbury for mild steel screw in brass nut, lubricated with heavy (mineral) machinery oil, are 0·110 to 0·190, with an average of 0·143, which compare with Col. 6 of the author's results, ranging from 0·140 to 0·177, with an average of 0·160. Ham and Ryan give a coefficient of 0·063 for kinetic friction of a hard steel collar on bronze and 0·081 for starting friction, compared with the author's figures of 0·115 and 0·16. They also give for screws kinetic coefficients of 0·10 to 0·15, with starting coefficients of one-third higher than these.

At the pressures and velocities given in Table I, which are normal for screws of this type, heating of the bearing faces of the thread takes place fairly rapidly if the operation of elevating and lowering is repeated several consecutive times, and these threads must therefore be cut with considerable longitudinal clearance, in addition to the usual 0·010in. of diametral clearance for Acme threads. The author finds that a longitudinal clearance of 0·003in. to 0·005in. is suitable for nuts up to 6in. long.

Lloyd's Register of Shipping.

ANNUAL SUMMARY.

THE statistics issued by Lloyd's Register of Shipping of vessels launched during the year 1934 show a notable increase, both at home and abroad, in the output of the shipbuilding industry, the total being nearly double the unprecedentedly low figure of 1933.

Particulars of Output.—Excluding ships of less than 100 tons gross, there were launched in the world 536 vessels of 967,419 tons gross, of which 459,877 tons were in Great Britain and Ireland, and 507,542 tons abroad. The output in Great Britain and Ireland represents 47·5 per cent. of the total, as compared with 27·2 per cent. in 1933, 25·8 per cent. in 1932, 31·1 per cent. for 1931, and 51·2 per cent. for 1930. The output of the other leading countries is as follows:—Japan, 152,420 tons; Germany, 73,733 tons; Denmark, 61,729 tons; Sweden, 49,542 tons; Holland, 46,905 tons.

The net increase in the world output as compared with the extremely low total for 1933 amounts to no less than 478,403 tons (97·8 per cent.). In Great Britain and Ireland there has been an increase of 326,762 tons in the tonnage launched, while abroad the increase amounts to 151,641 tons.

In Great Britain and Ireland, 24 vessels, of 46,757 tons, were launched for owners residing abroad, equal to 10·2 per cent. of the total output. Fourteen of these vessels, of 26,516 tons, will be registered in the British Dominions overseas.

The world launches for the year include 58 vessels of over 6000 tons each, of which 13 are of between 10,000 and 15,000 tons, and three of 15,000 tons and upwards. The quadruple-screw turbine express steamer "Queen Mary," built on the Clyde and named by Her Majesty, takes pride of place among the launches throughout the world during 1934, and other large vessels launched were:—Twin-screw turbine s.s. "Orion," 24,000 tons, built in Great Britain and Ireland; twin-screw turbo-electric ship "Scharnhorst," 18,000 tons, built in Germany; twin-screw motor ship "Pilsudski," 14,400 tons, built in Italy.

In addition, twelve motor ships of between 10,000 and 11,000 tons, eight built in Great Britain and Ireland and two each in Holland and Japan, were launched.

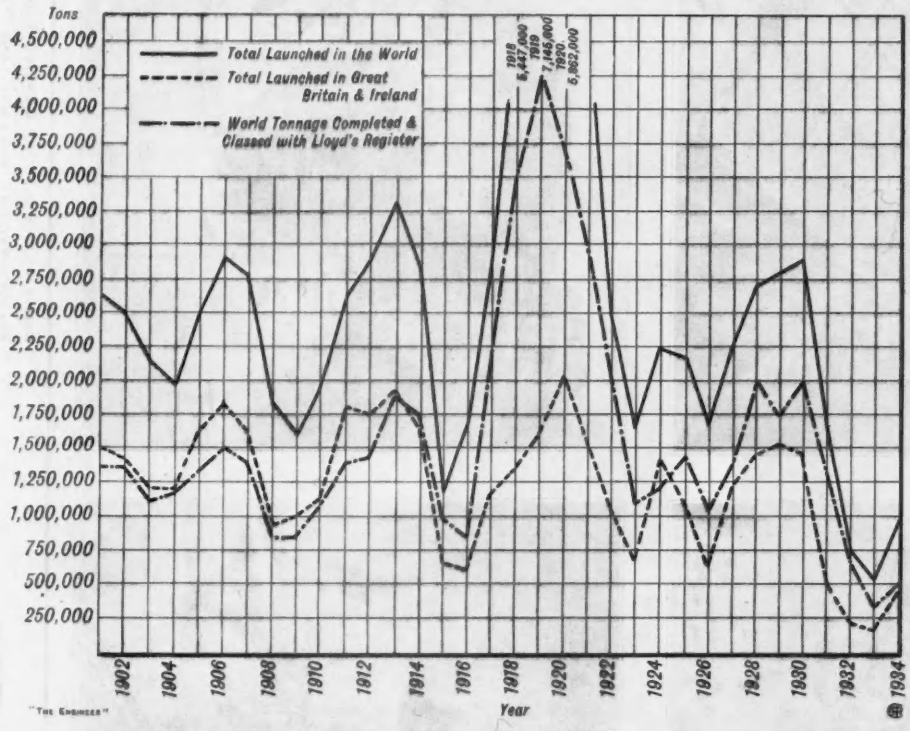
The total tonnage of steamers launched in the world is 391,176 tons, of which 269,277 tons (68·8 per cent.) were launched in Great Britain and Ireland and 121,899 tons

(31·2 per cent.) in countries abroad; while the total tonnage of motor ships launched in the world is 563,601 tons. Of these, 188,994 tons (33·5 per cent.) were launched in Great Britain and Ireland and 374,607 tons (66·5 per cent.) in countries abroad. During the year there were launched 17 vessels of about 170,000 tons, which are to be fitted with steam turbines. These figures include one vessel of 18,000 tons, in which turbo-electric drive is employed; in the remainder the turbines are associated with reduction gearing. In addition, there were launched 27 vessels of about 38,000 tons with a combination of steam reciprocating engines and low-pressure turbines. In Great Britain and Ireland there were launched eight turbine vessels of 113,864 tons, and four vessels of 12,057 tons with a combination of steam reciprocating engines and low-pressure turbines.

In the period under review 31 oil tankers, of 198,337 tons—excluding vessels of less than 1000 tons—were launched, of which ten of 69,066 tons were built in Great Britain and Ireland. Of the 31 tankers, 26 of 181,593 tons are motor ships. Of the steam tonnage launched in the world—391,176 tons—about 175,000 tons refer to steamers fitted to burn oil fuel under the boilers.

Progress of Shipbuilding During the Year.—Lloyd's Register Quarterly Returns show that at the opening of the year 1934 the tonnage being built throughout the world was 757,277 tons. The large increase of 322,000 tons at the end of the March quarter was followed by further advances in June and September. At the end of December the total was 1,251,722 tons, showing an increase of 494,445 tons as compared with December, 1933. The figures for Great Britain and Ireland for the same dates show an increase of 265,293 tons at December, 1934.

At the beginning of 1935, four countries had more than



NEW VESSELS CLASSED BY LLOYD'S REGISTER DURING THIRTY-FOUR YEARS

100,000 tons of shipping under construction, viz.:—Great Britain and Ireland, 596,834 tons; Germany, 139,611 tons; France, 120,952 tons; and Japan, 104,640 tons. Next in order were:—Denmark, 78,630 tons; Sweden, 60,140 tons; Holland, 48,333 tons; and Italy, 37,000 tons.

In view of the present figures of tonnage under construction, and taking into account the fact that the amount of tonnage laid down during 1934, as shown in Lloyd's Register Quarterly Returns, has exceeded by 227,000 tons the tonnage launched during the year, the position of the shipbuilding industry throughout the world reveals a gradual renewal of activity.

Vessels Classed by Lloyd's Register.—Of the merchant vessels launched during 1934, 199 of 714,857 tons (143 vessels of 427,744 tons in Great Britain and Ireland, and 56 of 287,113 tons abroad) were being built under the survey of the Society with a view to classification in Lloyd's Register Book.

The accompanying curves show the tonnage of new vessels classed by Lloyd's Register during each calendar year for the last thirty-four years. A notable feature disclosed by the figures given is that the average tonnage of new vessels classed by the Society for that long period (1901–1934) amounts to 1,554,118 tons per annum.

The Electrical Research Association.

AT a luncheon held at the Savoy Hotel on the occasion of the fourteenth annual general meeting of the British Electrical and Allied Industries' Research Association, the new President, Professor J. C. McLennan, F.R.S., delivered an interesting address covering various branches of electrical research. The knowledge of ionisation potentials, he explained, had led men in the great electrical companies to turn their attention to the production of enclosed gas arc lamps, and, judging from what could be seen on the roads near Wembley and Staines, the time might not be far distant when the old filament lamps would give place to those more modern lighting units. With the production of very powerful gas and metal vapour lamps, a simple and very economical method had been provided for the illumination of main roads which could be used at night with safety by motorists and others.

Great things had been accomplished through the science of thermionics, which had given the world the modern radio transmitter. It was amazing to go through such establishments as the General Electric Company's research laboratory and to see the large valves in which glass is sealed to quartz and to metal as easily as metal is soldered. But great as the progress in the development of valves had been, physicists were badly in need of a valve capable of giving waves 1 mm. long to investigate the solid properties of metals. By solving the problems involved in the production of such valves, the Research Association would render great assistance to the physicists.

He remembered a very strange thing happening when Dr. Whitney and his associates were developing valves for short-wave work in the General Electric Company's laboratories at Schenectady. On starting up the equipment men working in the laboratory became very uneasy and eventually got quite excited. A thermometer placed in the mouth of one of the men went up to 102 deg. or 103 deg., a very strange and curious effect to occur in connection with an industrial development. Experiments carried out by the speaker at Toronto with one of the equipments showed that there was a very remarkable selective action between the frequency of the waves, the conductivity of the medium traversed, and its dielectric constant, and there was no doubt that this was going to have ramifications of great importance to the electrical industry. It was possible to make the fat of a chop frizzle before the lean was even cooked.

With the aid of high potential equipments in places such as Cambridge and London, enormous velocities were being given to such things as electrons and protons, which were hurled against masses of metal with the result that they became radio-active. Those discoveries had led to the development of high potential equipments which had been used by doctors for the production of very penetrating radiations in order to treat the malignant growths found in cancer. It was highly probable that great developments in the production of apparatus capable of producing a million volts or so would be witnessed in the near future, but before it could be used therapeutically a vast amount of research work would have to be carried out, for no tube at present available was capable of standing more than 400,000 volts. If it became possible to apply 1 million volts to a tube, the question arose as to what would happen in the small gap between the anode and the cathode. Would nothing more than X-rays be emitted? All the things that emerged from the radiations would have to be studied before treating patients, and a vast amount of research work would have to be undertaken on the action of the radiations on tissue before the therapeutic value could be fully exploited.

Karl Compton, head of the Massachusetts Institute of Technology, brought to notice some two or three years ago a set of enormous spheres charged by frictional electricity up to a pressure of 10 million volts. Dr. Rayner, at the National Physical Laboratory, could easily produce a million volts, but Karl Compton and de Graaf were not only producing a pressure ten times that value for disintegrating the nuclei of atoms, but were suggesting that very high-voltage machines, consisting of very large discs revolving in *vacuo* and charged to these high voltages, might be used for long-distance transmission schemes. So feasible did the idea appear that it was proposed to ask President Roosevelt to make a grant for experimental work on a practical scale. The electricity would be transmitted along wires contained in vacuum tubes, but the task of keeping them properly exhausted would be far from easy. The dreams of physicists, however, came true, and electrical transmission as it was known to-day might easily take a very different form in the future.

SIXTY YEARS AGO.

SELF-PROPELLED road vehicles in 1875 had still a good way to travel before they were emancipated from the legislative restrictions which had been piled upon them. In some parts of the country, so we read in our issue of February 12th of the year named, people were coming to accept traction engines, if not quite as necessary evils, at least as appliances which did more good than harm. In other parts, however, parishes and even whole counties united in a determined opposition to their introduction. Actions were brought against the owners of traction engines because they did not "consume their own smoke" or because in some way or other they failed to comply with the Act of Parliament governing the use of mechanically propelled road vehicles. A recent case in the county of Montgomery was quoted by us as an instance of vexatious opposition and of the failure of the Act to achieve what its promoters intended. The owners of a traction engine made by John Fowler and Co. were prosecuted because the front wheels of their engine were not 9in. wide and were not smooth as required by the Act. Actually the wheels were 8½in. wide and had a central band 5in. wide and ¼in. thick. Wheels of this pattern were claimed by the makers to be the best that could be employed. On good roads the central band took the whole of the load on the front wheels and only on bad roads did this band sink into the surface far enough to bring the full width of the wheel into action. It was contended that the use of the central band reduced the tractive resistance of the engine and that the damage which a wheel so designed did to the roads was on the whole less than that which would be done by a smooth wheel. The magistrates decided against the defendants. Technically, in view of the requirements of the Act, their decision, we said, was no doubt right, but equally it could not be doubted that the Act was based on an erroneous conclusion. The object which it sought to achieve was the prevention of injury to the roads. That object, we contended, was not to be realised by laying down a standard wheel width irrespective of the weight of the engine and still less by requiring the wheels to be smooth. A traction engine wheel which did not slip did very little or no damage to a properly constructed road but one which slipped speedily ground holes in the surface. Actual experience showed, we said, that, all things considered, the best type of wheel for traction engines was one which was so far from being smooth that it was formed with diagonal strips all round the tire. We suggested that the owners of the Montgomery engine might serve a useful object if, taking the magistrates at their word, they fitted their engine with smooth wheels and ran it in that condition for a few trips. We imagined that the county surveyor, in spite of the Act of Parliament, would soon ask them to restore the hooped wheels or even to apply diagonal strips to the tires.

BRITISH STANDARDS INSTITUTION.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W.1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

MOTOR STARTERS AND CONTROLLERS.

Nos. 140—1935, 587—1935. A series of eleven B.S. Specifications for various types of motor starters and controllers was issued in 1923, and the whole series has now been revised. Instead of eleven separate specifications, however, there are now only two, namely, one for starters and controllers of the liquid type (B.S.S. 140), and one for all other types—except single-phase models, which are regarded as non-standard—(B.S.S. 587). The new specification No. 587, which takes the place of ten of the old series dealing with the non-liquid types of starters and controllers, runs to sixty-four pages, but twenty-five of them are devoted to terminal markings. This section deals for the first time in a comprehensive manner with the marking of both A.C. and D.C. control gear. It is understood that other B.S. Specifications will in due course be revised to include sections dealing with terminal markings, and with this in view the question of co-ordinating the terminal markings on all classes of electrical machinery was investigated a few years ago by the B.E.A.M.A. The terminal markings for starters and controllers now standardised by the B.S.I. are those given in the B.E.A.M.A. Report, and the markings are consistent with those for the motors.

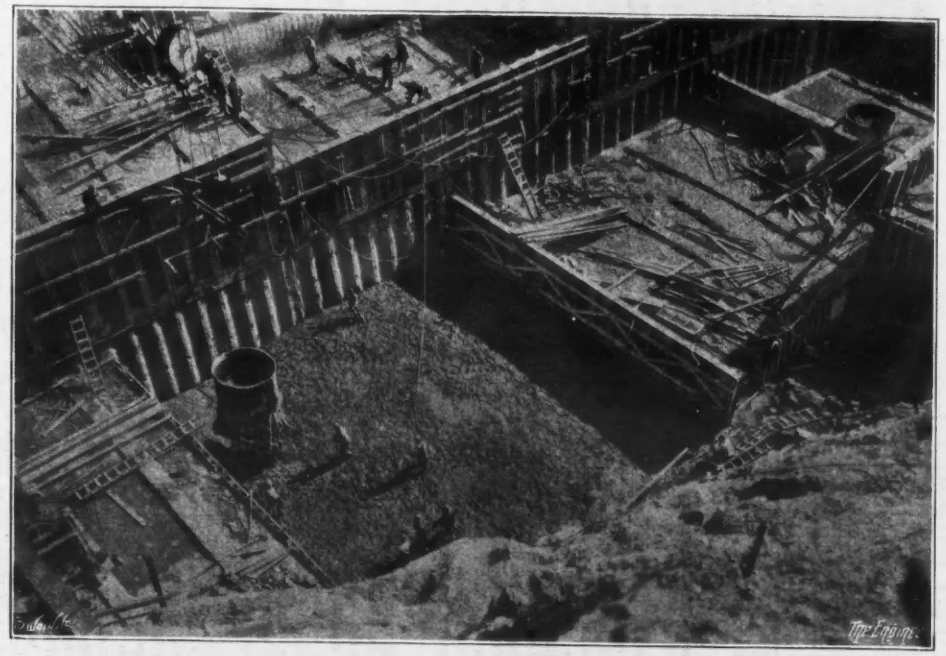
PHOTO-ELECTRIC CELLS FOR SOUND FILMS.

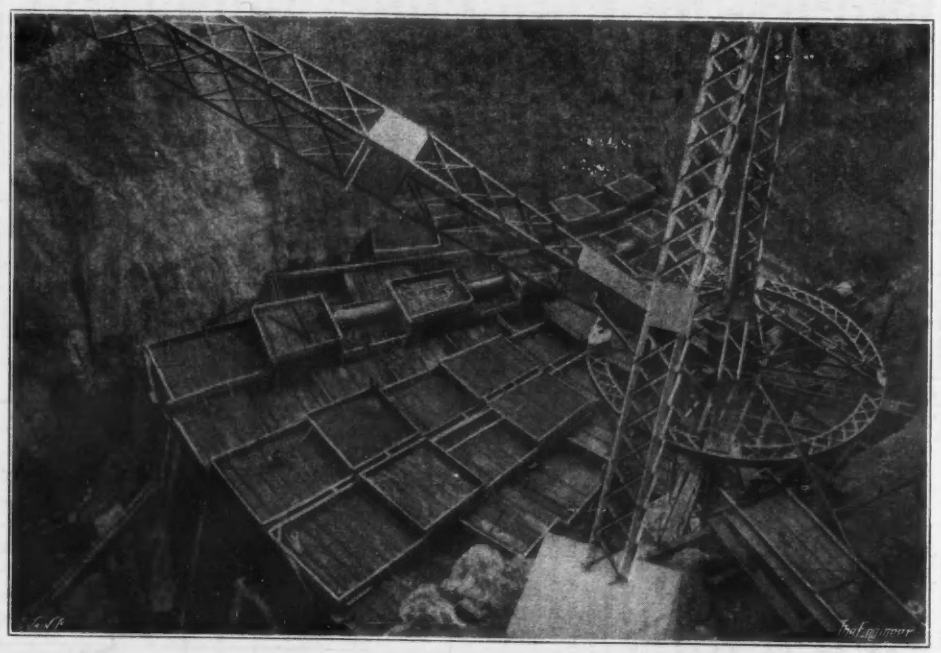
No. 586—1935. Since this specification defines the properties specified, there should now no longer be any excuse for misunderstandings between manufacturers and purchaser as to the meaning of such terms as "sensitivity" and "variation of frequency response." "Sensitivity" has no meaning unless defined in terms of a prescribed quality of the light and an ageing process prior to testing. The specification does not attempt to define the vague properties "microphonicity" and "background noise," but it is hoped that in later issues it may be found possible to enhance the value of the specification by rectifying this omission. An important feature of the specification is the standardisation of dimensions. The difficult problem of working voltage has been solved by prescribing one voltage as the standard, but allowing other voltages so long as their departure from this standard is clearly indicated.

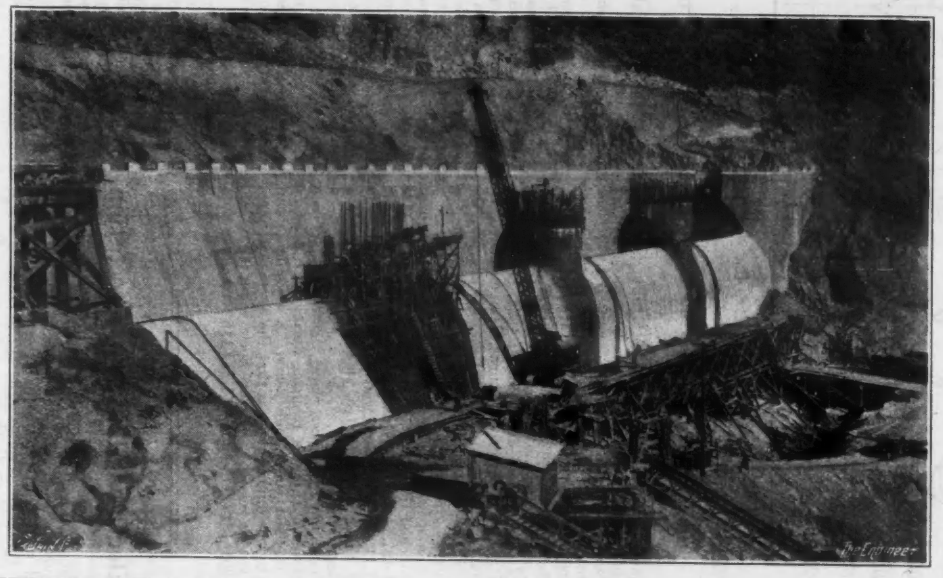
The limits assigned for the properties of the cells are admittedly wide. Some users will demand, and some manufacturers will offer, cells manufactured to closer limits. It was, however, thought wise that in the first issue of the specification the requirements should not be unduly stringent. The specification deals only with cells for sound film apparatus; it has no application to cells for other purposes.

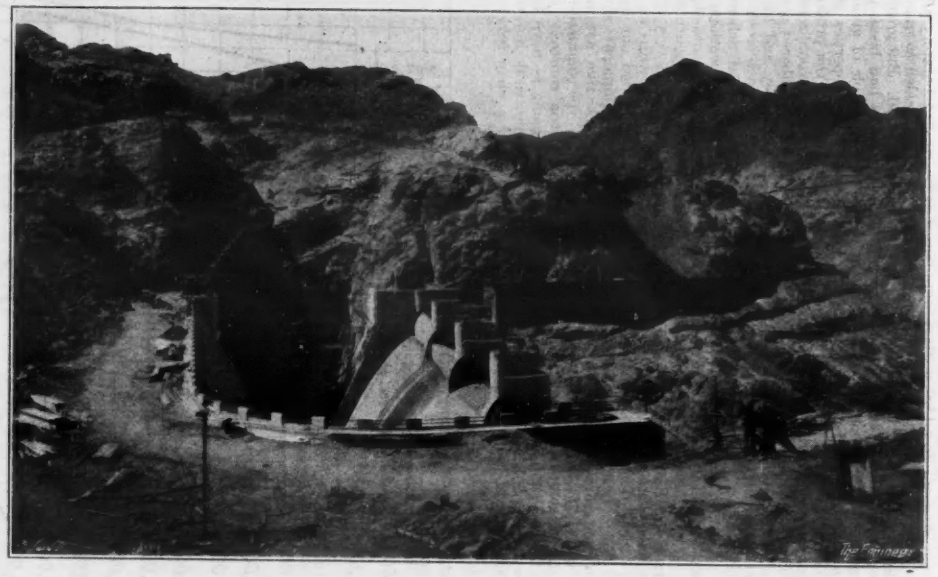
PROGRESS OF THE BOULDER DAM

(For description see opposite page.)









ABOVE:—8-YARD BOTTOM-DUMP BUCKET IN USE
BELOW:—NEVADA SPILLWAY—CONCRETING APPROACHING COMPLETION

ABOVE:—DERRICK, AND CONDITION OF DAM IN NOVEMBER, 1933
BELOW:—ARIZONA SPILLWAY, AND TUNNEL LEADING TO DIVERSION TUNNEL

Progress on the Boulder Dam.*

No. II.

(*Continued from page 155, February 8th.*)

FORMS AND CASTING METHOD.

AS previously mentioned a year ago, the dam is being reared primarily in the form of interrelated and interlocked rectangular columns, that will be bound together by grouted joints. In cross section these columns vary in their dimensions. The columns adjacent to the upstream surface of the dam measure 55ft. by 60ft. in section, while the columns at the downstream face are generally 25ft. by 30ft. in section. They have an average sectional area of 1430 square feet, and are poured in 5ft. lifts. In the upbuilding of the dam, the structure is divided broadly into two main divisions by a central 8ft. slot, which bisects the structure from face to face. Within each half-section the dam is further subdivided by the arrangement of the unit columns, familiarly spoken of as blocks. The blocks are disposed in radial rows that broaden out as they advance from the downstream to the upstream face of the structure—see accompanying bird's-eye view. In each row alternate blocks are so poured as to keep them a maximum of not more than 35ft. above the intervening lower blocks. Usually, the high blocks of a row, called leading blocks, are two lifts higher than the contiguous lower blocks. The leading blocks are poured with the use of forms on all four sides. The succeeding lower blocks, between two leading blocks, require forms only on two sides because the sandwiching leading blocks serve as forms for the other two sides. Between two parallel leading rows there is a lower row, and the low blocks of such a row require no forms at all owing to the fact that they are surrounded by higher blocks on all four sides. This procedure limits the number of forms needed, and the forms for any column can be used repeatedly for the succeeding lifts of that column. This staggering of the columns has made it possible to effect very substantial savings in outlay for forms. At the beginning of each working day an inspection is made to ascertain the heights of all blocks, and those that are lower than required by the schedule are brought up directly to their appropriate elevations, so that the stepped arrangement of the blocks will be maintained and excessive differences of heights avoided.

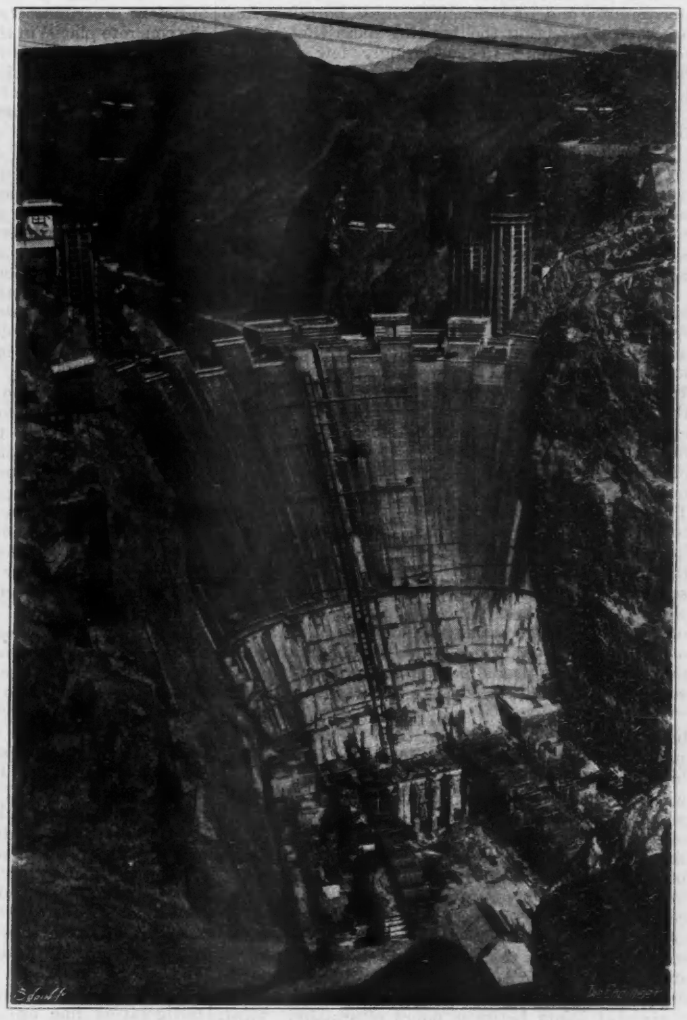
The forms generally used for the columnar blocks of concrete are wooden panels, lined with metal, and of the familiar cantilever type. Each form permits the pouring of a 5ft. lift, and attached to each form are vertical timbers that project downward below the form proper for 5ft. against the side of the preceding lift. Each form is further steadied by being partway tied in at its top by means of steel rods hooked at their lower ends to bolts embedded in the preceding pour and engaging she-bolts in the form near the top of the lift about to be poured. These braces are arranged approximately 3ft. apart. A form is raised to its new position a panel at a time, then carefully lined by means of the bracing described, and, when correctly adjusted, it is secured, the timber tail pieces being at that time bolted to the row below. The forms are capped with 12in. planking which, incidentally, serves for a walkway. Because the four corners of a given column of blocks rise in the same vertical line from the lowest to the uppermost lift, the form for each block is built especially for it, and is used for the surmounting lifts without the need of modification. Thus, a single form has served for fully thirty successive lifts and with the need of only moderate repairs called for by reason of buckets striking it. Forms are placed in their first positions by means of the cableways, and wherever it is necessary to shift a form afterwards horizontally this is also done by cableway. Vertical changes of position are effected by chain jacks and a suitable number of A-frames, varying from two to three according to the size of the form panels.

The 8-cubic-yard bottom-dumping buckets—page 170—are constructed of ¼in. steel plating, and are welded throughout. Since first developed by the contractor's general superintendent, the buckets have varied from their original dimensions of 6ft. in diameter and 8ft. in height. Each bucket is suspended from a cableway hoist and dump locks by two slings, respectively secured by suitable connections to the shell of the bucket, and to I-bars supporting the bottom-dump doors. Both slings are attached to the bucket by means of sockets and removable pins. Safety catches prevent the accidental opening of the doors while a bucket is in the air. The buckets were designed to satisfy a requirement that "a mixer batch, or a combination of mixer batches, shall be conveyed in one mass to its location in the dam," and also to meet the Government's specifications, which interdicted the continuous pouring of concrete at the dam. A later form of the 8-cubic-yard bucket is equipped with a manually operated radial gate, which makes it possible to pour concrete into forms which are so shaped or dimensioned that the large bottom-dump bucket cannot be used. This newer design of bucket is now employed for service where the 4-cubic-yard agitators were utilised.

Concrete from the Lo-Mix plant was hauled by one-car trains, each pulled by an electric locomotive designed to operate either with storage batteries or by third-rail transmission. Each car was divided into four stalls for the buckets, two stalls being occupied by loaded buckets on the outward-bound run, and the two empty spaces being available to receive discharged buckets to be returned to the mixing plant for filling. That railway was supported on the canyon wall where it crossed the dam site at El. 720—that is, at the crests of the two big cofferdams. The buckets were moved along the railway to points where they could be picked up by any one of the four cableways provided by the contractor for that purpose, and then transported to any point within the area to be occupied by the dam. As soon as the dam mounted to El. 720, the railway was halted at the upstream face of the structure, and provision had to be made to pick up buckets bound to and from the Lo-Mix plant, and to make them accessible to a cableway spanning the canyon downstream of that point. To this end, the contractor erected nearby, and at the level of the foundation of one of the intake towers on the Nevada flank of the gorge, a big steel stiff-leg derrick—see page 170—equipped with a 136ft. boom and a 500 h.p. hoist, and capable of lifting a load of 20 tons. The derrick made it possible to swing the buckets so that concrete from the Lo-Mix plant could be handled by cableway No. 6. Cableway No. 5 could reach the railway directly. Cableways Nos. 7 and 8 distribute concrete originating at the High-Mix plant.

It is readily understandable that the lifting, lowering, and travel of buckets containing unit loads of 16 tons of concrete called for a carefully planned and co-ordinated system of control that would effectually guard against confusion while still permitting notably rapid placing of the concrete. Strange

BIRD'S-EYE VIEW SHOWING BLOCK FORMATION—SEPTEMBER, 1933



DOWNSTREAM FACE IN SEPTEMBER, 1934.

* On Friday, February 1st, the gates were closed and the dam began to fill. It is estimated that it will take three years to form the vast lake behind the dam.

as it may seem, the signalmen employed to direct cableway operations are generally youths, and each has been chosen because of his quick responses and his inherent sense of rhythm, the latter gift playing a prime part in the skillful and speedy use of the cableways. The lads have been trained for their work with the aid of duplicate sets of headphones, which they wear while sitting beside the regular signalman during a shift and listening at the same time to the orders despatched to the hoist operator. At each cableway there is a signalman at the loading point and another at the pouring place, and both are linked by the same telephone circuit with the cable operator, who is out of sight. The signals are by voice, light, and bells. The signalman at the railway directs the lifting of a loaded bucket or the lowering of an empty one on to a train. The instant the bucket starts outward toward the dam the other signalman takes over the directing and assumes charge of the spotting, the landing, and the dumping of the bucket. With those operations completed, he continues to control the handling of the bucket by the cableway until it has been returned to a point above the railway, when the signalman there resumes command in getting the bucket back on to a car. No one acquainted with similar work will be unmindful of the quick and instant action demanded of the signalmen, especially when the bucket and its load weigh 20 tons and the cableway carriage travels on much of its run at a rate of 1200ft. per minute, and its momentum must be taken into account in directing the hanging mass that swings like a pendulum. In surprisingly few instances have the buckets hit either canyon wall or struck the forms in handling on to a given block.

Each lift is finished with horizontal keys 26in. by 5½in. in vertical section, spaced 10ft. apart. In pouring the first concrete of a lift, the buckets are landed on these keys so as not to crush the piping of the concrete cooling system which is then exposed on the upturned surface of the block, and this concrete serves as a protecting blanket for the circulatory system during the pouring of the remainder of a given lift.

Government specifications required that the concrete for each lift of any block should be placed in five successive 1ft. layers. Owing to the very dry air of the region and the heat in the warm months, it was soon discovered that the exposed surface of a 1ft. layer was likely to dry too quickly. To minimise this action another procedure was adopted; the concrete was deposited to a maximum depth of 5ft. as fast as possible across the entire downstream section of a block, the concrete being allowed to take its natural slope towards the upstream side of the form. The remainder of the concrete was then placed so as to fill up the space within the form to complete the lift. This method has become standard, except during the cold months, when the concrete is deposited in successive 1ft. layers. By placing the concrete on a slope a wedging action results, which tends automatically to compact the mass. Because of the nature of the concrete used at Boulder Dam, vibrators are not employed to promote compacting, except at the corners and around the edges of a block.

When a 5ft. lift has been poured and the concrete has taken its initial set, then the exposed upturned surface of a block is washed vigorously with a combined compressed air and water jet, and that is done when the concrete has hardened just enough so that jetting will loosen and carry away a desired small measure of the surface concrete. This produces a sharply cut surface that helps to make a superior bond with the next lift. Before the next lift is poured, however, a 1in. layer of grout, made up of sand, cement, and water, is spread on top of the form and rubbed in with brushes. Laboratory tests of bonds resulting from this treatment have shown an average strength of 92 per cent. of the strength of the concrete itself. The grouting has been found to seal horizontal joints between pours effectually. Horizontal joints in concrete dams often afford channels for considerable leakage. On an average a period of ninety minutes is required to pour a block 30ft. by 25ft. in cross section. After pouring a 5ft. lift there is ordinarily a wait of seventy-two hours before pouring the succeeding lift; but pouring goes on continuously owing to the numerous blocks that are under construction. The forms are shifted usually twenty-four hours after the pouring of a lift.

The sides and upturned surface of a block are continually sprinkled during the curing period. Perforated pipes, attached to the bottoms of the forms, sprinkle the lift last poured, while men equipped with hose sprinkler do the work on the tops of the curing blocks. A larger force is so engaged in the daytime in the summer season than is required after nightfall. The waste water from the sprinkling operations is led to a shaft below the level of the dam foundation, whence it is pumped into one of the diversion tunnels. The water used for sprinkling contains iron, which stains the surface of the dam and gives it a mahogany hue, which blends well with the colouring of the canyon walls. Thermometers, strain meters, and some other instruments are embedded in the concrete at frequent intervals with their connections carried out to the central 8ft. slot, where connections are made with reading and recording apparatus. Drainage tiles, of 8in. internal diameter, of a special concrete, are arranged vertically on 10ft. centres horizontally at each side of the axial 8ft. slot. Clean-up water is also disposed of by a drainage system cast in the dam structure that carries water from low blocks, temporarily serving as sumps, to 6in. headers which convey the water to the nearest face of the dam. The waste water is led to wells, allowed to settle, and then pumped back into the supply lines.

All cement used for grouting is prepared in an auxiliary plant adjacent to the Hi-Mix plant, and there will be screened approximately 30,000 sacks of cement for use in connection with the grouting of both radial and circumferential contraction joints in the dam. The cement employed for this purpose is blended cement which has been passed through a 200-mesh screen, and none of the screened cement can be utilised in a grout mix if more than seven days old from the screening plant. This cement is packed in paper sacks for convenience of handling, stored in a nearby warehouse, and then delivered in the required quantities to the different grout pumps. The radial and the circumferential contraction joints are grouted separately, and metal stops are placed so as to prevent communication between the two joints during grouting. In grouting, sufficient pressure is applied to the fluid to obviate the formation of air pockets, to consolidate the grout, and at the same time to drive the water from the grout and to force it into the adjacent concrete of the blocks.

Cooling Plant.

Before describing the method followed in cooling the concrete placed in the dam structure let us outline the principal features of the cooling plant that has made it possible to dissipate rapidly the heat generated during the hydration of the concrete. The plant may be properly divided into two sections—one an atmospheric cooling tower and the other a battery of ammonia refrigerating compressors. The three compressors are each driven by a 250 h.p. motor, and after these units had supplied operating air for rock drills and other pneumatic equipment their air cylinders were removed and ammonia cylinders substituted, which have a combined refrigerating capacity of 825 tons. Allowing for losses in the plant and line, there remains an effective capacity of 775 tons. The cooling tower of the atmospheric system was erected on the crest of the downstream cofferdam. It is built of redwood and is 43ft. high, with ground plan dimensions of 16ft. by 150ft. By reason of the low humidity of the region and the active circulation of air in the canyon, the cooling tower has the equivalent of approximately 900 tons of refrigerating capacity. The cooling tower uses desilted water obtained from the river, and the water is thus cooled to a temperature of 70 deg. or less. The refrigerating plant chills the water supplied by it to a temperature ranging between 47 deg. and 40 deg. Fah. When operating at maximum capacity the cooling tower has handled 6000 gallons of water per minute, 3000 gallons of which has been condenser water fed back from the refrigerating plant.

The cooling of the concrete is done in two stages; in the first stage air-cooled water is used, and in the second stage the refrigerated water carries the cooling of the mass concrete to its final required temperature. As a matter of economy the water used in both systems is circulated through closed circuits, and make-up water is needed principally to take care of evaporation at the cooling tower. This make-up water is obtained from a sump situated between the two cofferdams. The cooling water is delivered to the dam through two 14in. headers and returned to the tower and the refrigerating plant in similar mains. The four mains extend to the downstream side of the 8ft. central slot that bisects the dam during construction, and these mains are being carried upward as the dam rises. Leading off from these headers are connecting 6in. horizontal headers which are hung on the two walls of the slot and reach to the upstream face of the structure. The 6in. and the 14in. headers of the refrigerating line are insulated with 2in. of cork. Water from the cooling and the refrigerating systems is distributed through the circulating coils embedded in the concrete, and the coils are connected with the supply and the return headers by means of short lengths of rubber hose and standard fittings. Changes in this important installation have been made as experience has shown where alterations would lead to economy and to greater effectiveness.

(To be continued.)

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

ARTIFICIAL MANIPULATION OF TREND.

SIR,—The problem raised by Mr. D. Lloyd in last week's ENGINEER presumably relates to forecasting future supply or demand of water, and he has used the method described by me (THE ENGINEER, December 30th, 1932, page 661) by drawing a regression line of least squares, with associated standard deviations, and extrapolating for the forecast. His difficulty seems to be that the restricted supply of last summer has taken his recent dots on the diagram outside the limits of probability, and he asks in effect if it might not be legitimate, in future forecasts, to disregard the effects of an "Act of God"? The reply is in the negative. In statistical forecasting, all the data available must be used. An engineer's temptation, in smoothing a curve, is to leave out inconvenient figures. This is ethical only when there is a strong suspicion that the observed quantity is incorrect. What nearly always happens in a time series is that the occurrence of an exceptional event influences the future. When the circulation of a daily newspaper goes up excessively on account of a murder mystery, some of the excessive circulation is retained. It is highly probable that one season's restricted water supply will affect the habits of consumers, and in any case a forecast should take note of the possibility of another dry season.

There are legitimate ways of saving labour in calculation. Mr. Lloyd's regression line, &c., having been calculated from a past series, it should be valid as an instrument of statistical analysis for a few more members of the same series. A "lane" drawn on the method of standard (or, in this case, of skew or regressional) deviation, is based strictly on the theory of probability, but for industrial or commercial purposes mathematical exactitude is not essential. From experience a forecaster may establish arbitrary limits of permissible variation, say, 5 per cent., or some figure approximate to the calculated deviation.

By using the method described, a water engineer, from his records, should be able to isolate controllable causes of variation, separately estimating the demands due to domestic, industrial, civic, and other purposes, finally making an estimate of total demand, and allowing for a factor of safety. A factor of safety calculated from the theory of probability is more logical than thinking of a number, doubling it, and adding a lot more to it! Most engineering factors of safety are empirical.

Mathematically speaking, the use of a line of least squares is not justified for extrapolation. The method of analysis, invented by Dr. W. A. Shewart and developed by myself, is primarily analytical, and is used by Dr. Shewart for controlling the production processes of the Bell Telephone Company. When dots on such a diagram fall in unexpected positions, they are warnings that the cause of excessive fluctuations should be investigated. In Mr. Lloyd's example the cause was already isolated, and this cause must be taken into consideration. If disregarded, it would, as Mr. Lloyd rightly says, "upset the theory of probability."

DUDLEY W. WALTON, F.S.S.

Teddington, February 11th.

MULTIPLE EARTHS AND CABLE FAULTS.

SIR,—The paper published in the January "Proceedings" of the Institution of Electrical Engineers, and contributed by Mr. C. M. Longfield, M. Eng., opens up an important question in view of the increased electrification in this country and the multiple earthing of systems.

It appears from Mr. Longfield's paper that he has been able to reduce cable faults to a very large degree by the application of drainage valves, which, owing to legislation in this country, are prohibited here.

The problem is one which affects all classes of engineering, as gas and water distributors are equally involved with electricity suppliers and communication systems.

Owing to the rapid development that is taking place in all these public services, the time appears ripe for the collection of data, and the consideration of such with a view to the modification of legislation if necessary. The existing legislation has remained practically the same since 1893, since which date all the developments in electric traction systems have taken place, and, further, the legislation appears in some cases to bear unduly heavily on the distribution authorities.

WESTINGHOUSE BRAKE AND SAXBY SIGNAL COMPANY, LTD.,
L. H. PETER, M.I.E.E.,
Chief Electrical Engineer.

London, N.1, February 7th.

IRAQ PIPE LINE.

WE have to express our regret that we were misinformed with regard to certain sub-contractors for the Iraq pipe line.

From material officially supplied to us we took the statement that Worthington-Simpson and Laurence Scott had supplied the main centrifugal loading pumps and their motors. We are now informed that both the pumps and the motors were supplied by Mather and Platt, Ltd.

In the same article, on page 93 of our issue of January 25th, we stated that a sixteen-feed Wakefield lubricator was used on the Worthington-Simpson pumps. We now learn that the information supplied to us was wrong and that everyone of the forty-five Worthington-Simpson pumps is equipped with lubricators supplied by J. and W. Kirkham, Ltd., of Bolton. The lubricators are of the makers' standard "T. and K." design, somewhat modified to meet the exacting conditions of the specification. With regard to the actual description of the lubricators, the following amendments should be noted. There are five—not four—suction pumps at the back of the lubricator box, the central pump feeding oil to the lubricator box whilst each outer pair of pumps is connected to the pinion shaft bearing only, the remaining points on the pump being lubricated by the sixteen T. and K. pump units on the front of the lubricator.

Whilst we cannot accept responsibility for these mistakes, we desire to express to Mather and Platt, Ltd., and J. and W. Kirkham, Ltd., our apologies for any inconvenience they may have been caused by them.

Rail and Road.

THE Minister of Transport has decided to reduce the Menai Bridge tolls for all vehicles except motor cycles by 50 per cent. as from April 1st next. In the case of motor cycles the toll was reduced from 6d. to 3d. on April 1st, 1934. A reduction of 50 per cent. will also be made in the price of quarterly season tickets.

IT is announced by the L.M.S. Company that, in conjunction with Armstrong Siddeley Motors, Ltd., it is about to conduct trials of a 56-seater railcar known as the "Coventry pneumatic railcar." This vehicle, which is intended for services of a secondary express character, is capable of a maximum speed in the vicinity of 70 m.p.h., and runs on sixteen wheels fitted with rubber tires.

THE retirement of the mineral manager of the L.M.S. Railway has led to that office being discontinued. It was a position that was almost peculiar to the former Midland Railway, as that company carried more coal than any of the other companies; at the beginning of the present century, the mineral receipts of the Midland were £3,300,000 a year, as compared with £2,000,000 on the Great Western.

THE President of the Institution of Railway Signal Engineers for 1935–36 is Mr. H. E. Morgan, the western divisional signal and telegraph engineer, London, Midland and Scottish Railway. Mr. Morgan started his railway career on the Taff Vale Railway in 1896, left there in 1902, and was with two firms of signalling contractors, and then joined the Midland Railway in 1911. At the time of that company's incorporation in the L.M.S. system, Mr. Morgan was the chief assistant signal superintendent to the Midland, and later succeeded his then chief, Mr. W. C. Acfield, and eventually went to his present position in 1929.

THE report of Colonel Trench on the fatal derailment of a passenger train on November 27th at Wormley was issued on February 8th, and is reviewed elsewhere in this issue. It will be remembered that this was the second case last year, when a passenger train ran into a motor vehicle at an occupation crossing. The previous case, as related in a leader in our issue of December 28th last, was at an occupation crossing between Freshfield and Formby, on the Liverpool-Southport line. There was no derailment there, but at Wormley the engine and most of the train were derailed and the driver and fireman were killed.

THE new western exit from London, formed by the Chertsey Arterial Road, will shortly be extended from Chudleigh Estate, to Hospital Bridge-road, Twickenham, a distance of nearly 1½ mile. This section of the road is estimated to cost £72,398, and the Minister of Transport has made a substantial grant to the Middlesex County Council from the Road Fund to enable work to begin as soon as the negotiations for the acquisition of the necessary property are concluded. In accordance with the Minister's policy, separate carriageways will be provided for the up and down streams of traffic, and footpaths will be provided on both sides. The work is expected to be completed in about eighteen months.

SPEAKING on January 26th at the annual dinner of the Permanent Way Institution, with Mr. W. K. Wallace, the new President, in the chair, Mr. E. J. H. Lemon, one of the Vice-Presidents, L.M.S. Railway, said that one means by which scientific methods could be employed was in the use of the ciné-cinema. A slow-motion picture might reveal faults which would escape the notice of a person actually watching the operations. A great drawback in the organisation of big concerns such as railways was the difficulty in getting in touch with the man who actually did the work. Travelling round the districts took considerable time, but there was no reason why the "talkie" film should not be used as a means of acquainting the staff of the best way of doing a job.

IN each of the last two quarterly returns of railway accidents inquired into—those for the March, 1934, and June, 1934, three months—there was a report on a fatality that occurred whilst engineering assistants were making surveys on the line. In the first case a draughtsman, with two permanent way men to assist him, was making a survey near the mouth of a tunnel, and Mr. Moore remarked that the man made a serious error of judgment in not obtaining the necessary protection before starting work; but the question was whether a draughtsman was a competent man to decide when a look-out man was required. The conditions in the second case were of a different character. The work was the chaining of a double line, and therein a draughtsman had been engaged almost exclusively for the last twelve years. On the day in question he had passed a double line on to a single track, where watch had to be kept for trains from either direction. Here, again, he made an error of judgment in failing to make definite arrangement to ensure that a constant look-out was maintained.

THE sixteen days' hearing before the Railway and Canal Commission in the Southern Railway Rating Appeal ended on Wednesday, February 6th. The case is very complicated and cannot be compressed into a few lines, so it must suffice to say that the Railway Assessment Authority, set up under the Railways (Valuation for Rating) Act, 1930, to deal with the old and very troublesome question of the valuation of railways for rating purposes, assessed the value of the Southern Railway Company's hereditaments for the year 1931 at £2,180,000. The railway company appealed on a claim that the amount should be £500,000. The Corporation of Croydon, the Middlesex County Council, the London County Council, and the Corporation of Brighton also appealed with a view to the assessment being increased; their figure was £3,000,000. The judgment of Mr. Justice Mackinnon—Sir Francis Taylor and Sir Francis Dunnell, the two other members of the Commission sitting with him and concurring in the judgment—was that the net receipts were £5,408,000—an agreed figure—and from that the amount, in the Court's opinion, to be deducted was £4,330,869, leaving £1,077,131 "as the net annual value of the company's undertaking as a whole."

Miscellanea.

THE London and Home Counties Joint Electricity Authority are to spend £10,000 on the erection of a new central district office in Hellyfield-road, Surbiton.

THE new wireless station which has been installed near St. Nazaire will be the most powerful in France, and will permit direct communication with America. There are two sections, 15 miles distant from each other, the emission centre at Severac and the reception centre at La Pommeraye, near St. Nazaire.

SOME very remarkable X-ray mutants, or "sports" of plants, have, according to the *Industrial Bulletin* of Arthur D. Little, been produced by scientists of the General Electric Company; for instance, a grape fruit plant which flowers and bears the same year the seed is planted. A remarkable X-rayed barley grows on a trellis as a vine.

THE official returns rendered to the Electricity Commissioners show that 1714 million units of electricity were generated by authorised undertakers in Great Britain during the month of January, 1935, as compared with the revised figure of 1536 million units in the corresponding month of 1934, representing an increase of 178 million units, or 11·6 per cent.

A NOTE in the *Chemical Trade Journal* says that E. I. du Pont de Nemours and Co., in the U.S.A., has perfected a new explosive which is claimed to offer a high degree of safety in use and handling. The explosive, called Nitramon, is composed of nitrate of ammonia, with a special carbon compound. Its explosive force is said to be 20 per cent. greater than that of TNT, and it cannot be set off by heat or percussion, even by means of a bullet fired from a rifle or the blows of a trip-hammer.

THE Ontario Hydro-Electric Power Commission is quoting a new rate for the supply of electric power to Ontario's steel furnaces. The charge for this purpose is to be two-fifths of a cent per kWh, with a minimum monthly charge of 25 cents per horse-power. Electricity will be used in the operation of furnaces for the manufacture of steel billets, later to be processed into rods, plates, bars, &c. At the present time, there is imported into Canada a considerable volume of steel billets, and many grades of special alloy steels, which can be manufactured successfully in electric furnaces.

SUFFICIENT energy to operate an electric motor can be obtained directly from sunlight with a new photo-electric cell that has been produced in the General Electric research laboratory at Schenectady. Even the light from an incandescent lamp, falling on such cells, is sufficient to operate the motor. Four of the cells, connected together, operate a motor that is rated at four ten-millionths of a horse-power, and enough light energy is converted into electricity when a 75-watt incandescent lamp is lighted at a distance of 8in. from the cells to turn the motor, using three ten-thousandths of an ampère.

A REPORT issued by the Post Office states that the number of exchange telephone lines in the London area increased during 1934 from 477,000 to 506,000, an increase of 6 per cent., compared with 3 per cent. in 1933, and the number of telephones increased by 52,000 to a total of 872,000. Calls originated in the area numbered 857,000,000, compared with 798,000,000, an increase of about 7 per cent. Effective inland calls originated in the London area numbered approximately 4,248,000, compared with 3,453,000. The number of international outgoing calls dealt with was approximately 685,000. There are now 246 exchanges in the area, 77 being automatic, and the number of call offices increased from 9300 to 9900.

RECENTLY, experiments in Bangalore, India, reported in the *Chemical Age*, showed that shellac can be deposited electrically from its solution in alkalies. Apparently, the process may be applied either for the purification of shellac, or for its intimate admixture with other materials, including rubber. Electro-deposited shellac is not as soluble as usual in alcohol, but this solubility can be restored by proper treatment with acetic acid. The first attempted practical applications are for the recovery of shellac from scrap and waste on the one hand, and for the direct application of insulation to copper wires on the other. Wires treated with mixtures of shellac and rubber, after a conditioning treatment, are said to be well and strongly insulated.

IN a paper dealing with the physical properties of glass, Dr. W. M. Hampton said that the tensile strength of glass was a property which was found to vary to a considerable extent among specimens taken from the same batch of glass. No satisfactory explanation of this had yet been given, but it was known that the tensile strength of glass in thin threads was greater than in large sizes. Mattresses built up of a large number of fine threads had a greater tensile strength than solid glass of the same sectional area, and the variation in tensile strength between similar mattresses was not so great. This was because the variation in tensile strength which existed between one thread and another was eliminated owing to the large number of threads present.

IN a paper by J. R. Thoenen, of the U.S. Bureau of Mines, on sand and gravel excavation by slack-line cableways, the author points out that the shovel dipper, drag-line, or crane bucket is in contact with the deposit for a limited time in which to load. If for any reason it is not filled in that time, it must be returned for another attempt or swung with a partial load. The drag-line can vary this by increasing the dragging distance. On the other hand, the power scraper, if not immediately filled, can usually complete its load as it proceeds without loss of time. Therefore, cemented gravel or boulders do not offer the same delay to loading time as they do in other types of equipment. For instance, the scraper may fail to bite through a cemented deposit at one point on its first trip, but will pick up its load beyond. Each subsequent trip, however, it will tear away more of the cemented material until finally it cuts clear through. In heavy boulders it may ride over them at the start, but will pick up a few and string the others out along its path so that they can be caught on subsequent trips.

Air and Water.

A NEW airport is to be built at Ringway, near Manchester at a cost of £179,000.

LAST year the quantity of coal shipped to coastwise ports reached 21,352,267 tons, compared with 19,496,673 in 1933.

THERE are now twenty-one licensed municipal aerodromes in this country and seven other sites have been purchased.

THE United States Naval Base at Pearl Harbour, Hawaii, is to be strengthened and extended at a cost of some 15 million dollars.

GERMAN shipyards have recently secured orders for six oil tankers, two of 6000 tons each and four of 1500 tons each, from the German-American Petroleum Company.

IT is reported that the Royal Holland Lloyd has decided to suspend its passenger service to South American ports, and to maintain a regular service with cargo steamers only.

THE Chairman of the Ferries Committee at a recent meeting of the Birkenhead Town Council said that since the opening of the Mersey Tunnel the ferries had suffered a loss of some £52,000.

THE German and Spanish Governments have come to an agreement whereby German airships operating a service between Friedrichshafen and South America shall have landing-places at Barcelona and Seville.

DURING the week ended February 1st, 988 vessels, representing 961,880 net register tons, used the port of London; 431 vessels were to and from Empire and foreign ports and 557 vessels were engaged in coastwise traffic.

A NEW passenger aeroplane built on the Monospar system is being constructed at Hanworth. It will carry a crew of two and ten passengers, and will have a range of 600 miles and an estimated top speed of 208 miles an hour.

THE purchase of the Red Star Line, including the vessels "Pennland" and "Westernland," by the Arnold Bernstein Shipping Company of Hamburg, has been completed, and a new Red Star Line under the German flag is to operate from Hamburg.

WITH the object of testing the respective merits of large flying boats and small fast land aeroplanes, on ocean air mail routes, the French Government has ordered two de Havilland "Comet" machines, similar to those used in the England to Australia air race.

THE City Lands Committee, which has had the question of an airport for London under consideration since December, 1933, has asked for £750 with a view to inspecting sites and existing municipal airports, and to engage such professional advice as may be deemed necessary.

THE battle-cruiser H.M.S. "Hood" is now in dry dock at Portsmouth for repairs to the damage done when she came into collision with H.M.S. "Renown" off the coast of Spain. According to reports, one of her propellers is stripped and a certain amount of damage has been done to the port bilge.

THE new French liner "Ville D'Alger" has been launched, and when completed will go into service between Marseilles and Algiers. Her dimensions are:—Length overall, 465ft. 6in.; breadth, 63ft.; loaded draught, 21ft. 6in.; displacement, 8700 tons; and she has accommodation for 1014 passengers.

THE L.M.S. Railway reports a record flight from Belfast to Liverpool and Croydon recently by the Railway Air Services air liner "Mercury." The machine left Belfast at 9.35 a.m. and arrived at Liverpool at 10.40 a.m., and Croydon at 12.4 p.m., the actual average flying speeds being 151 m.p.h. from Belfast to Liverpool and 169 m.p.h. from Liverpool to Croydon.

THE municipal authorities of Amsterdam have prepared plans for the future development of their territory. The plans provide for the construction of a series of new harbours in direct communication with the North Sea Canal, with approximately 8 miles of new quays for seagoing ships, and over 17 miles for smaller craft. About 2000 acres of ground have been reserved for new industries.

THE first order for a marine type monotube extra high-pressure boiler has been placed with Sulzer Brothers by the Rotterdam Lloyds. It is to be installed on the single-screw steamship "Kertosono," which has five Scotch type boilers, one of which is to be replaced by the new boiler. The ship has a double casing turbine and a new high-pressure turbine is to be introduced between the high-pressure and low-pressure casings.

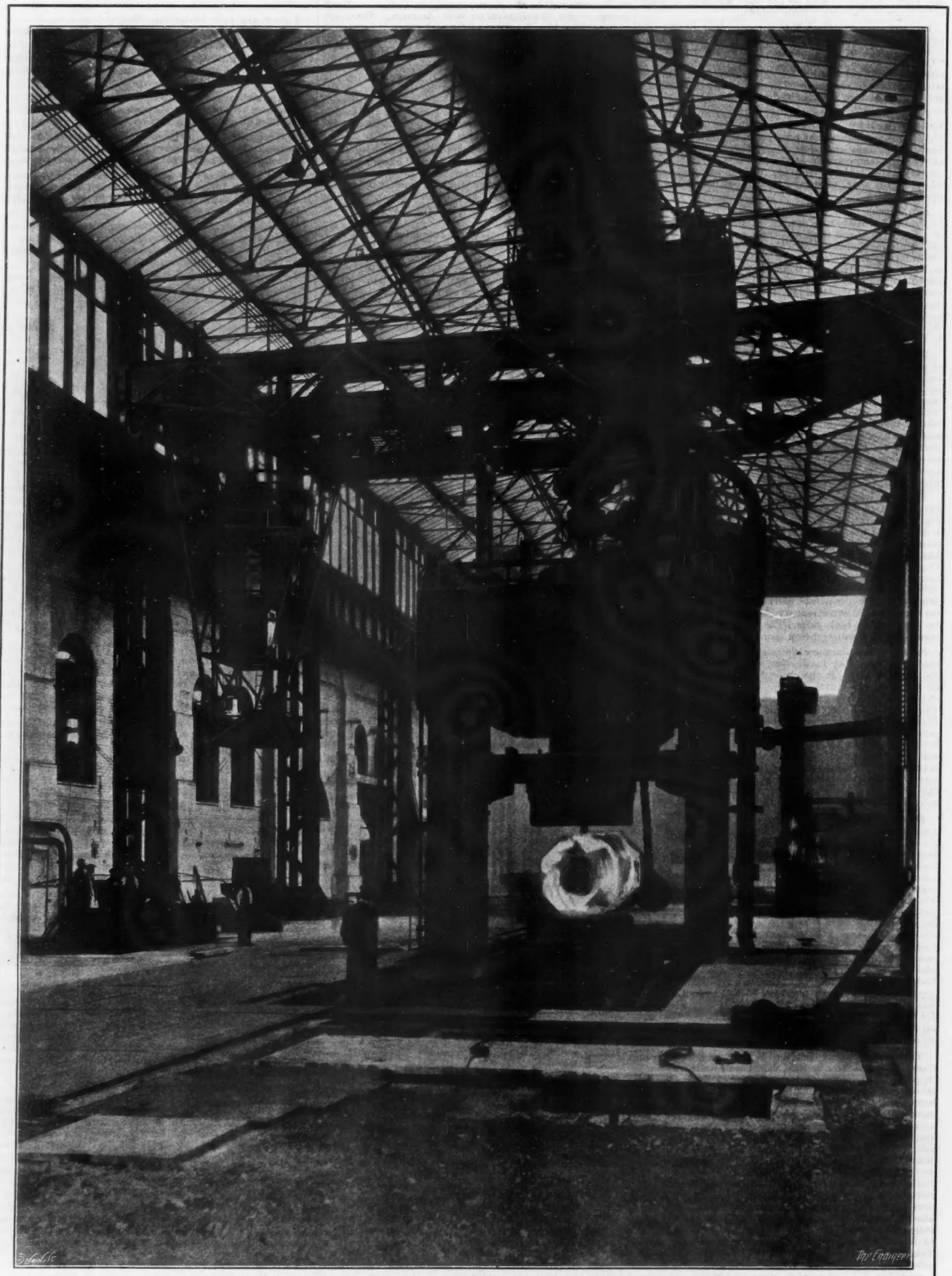
AN order for an unusual type of paddle tug has been placed with the Ardrossan Dockyard, Ltd. The vessel can best be described as an independent paddle-wheel heavy oil engined tug, propelled by two main oil engines, each coupled to the paddle wheel through a clutch, patent flexible coupling, and a geared reduction gear, this method being considered preferable to the Diesel-electric system. The tug has been designed for towing two 300-ton lighters on the river Euphrates.

A REPORT to be submitted to Poplar Borough Council states that during 1934 there was only one canal boat inspected. "It would appear," the report states, "that, owing to changed business conditions and methods of transport, the old type of canal boat is disappearing. A number of these vessels, which formerly were seen at more or less regular intervals, have ceased to ply, and have been replaced by other vessels, the registration of which does not come under the Canal Boats Acts."

THE motor ship "Manoora," of 10,800 gross tons, built by Alexander Stephen and Sons, Ltd., Glasgow, for the Adelaide Steamship Company for service in the coastal trade of Australia, underwent successful trials in the Firth of Clyde last week, and left the Clyde on Tuesday afternoon for Sydney. On arrival in Sydney the "Manoora" will be placed in service between Cairns, Queensland, and Fremantle, West Australia. Two other large ships for the coastal trade of Australia are being built in this country to the order of other shipping companies.

THE ENGLISH STEEL CORPORATION LTD.—7000-TON FORGING PRESS

(*For description see page 178.*)



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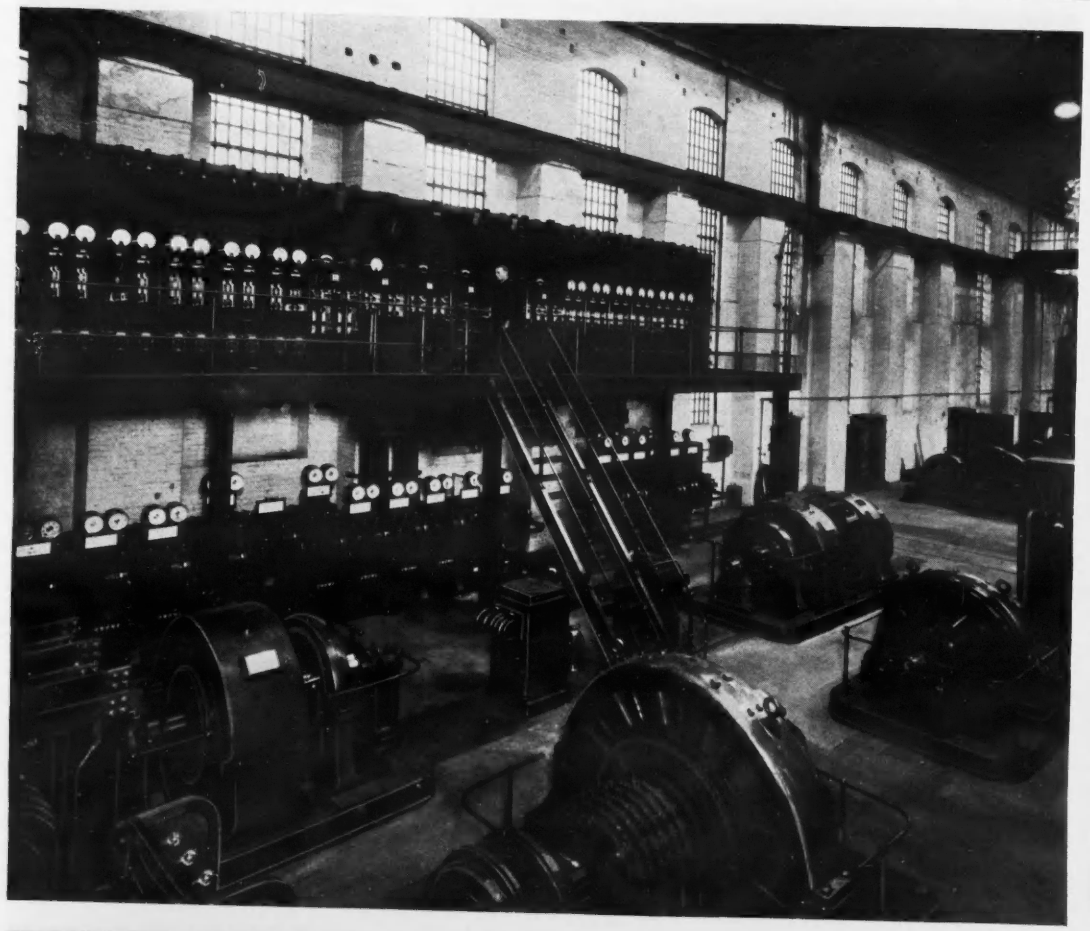

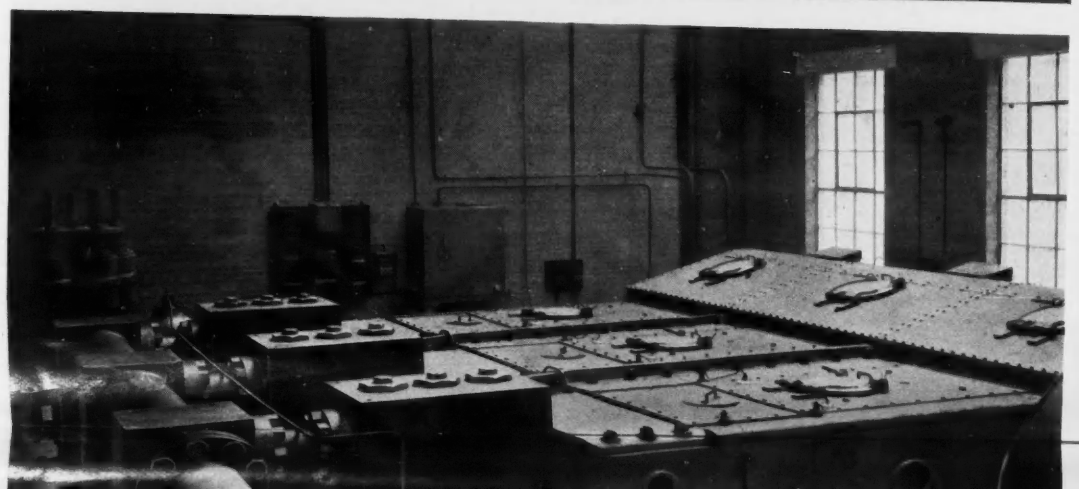

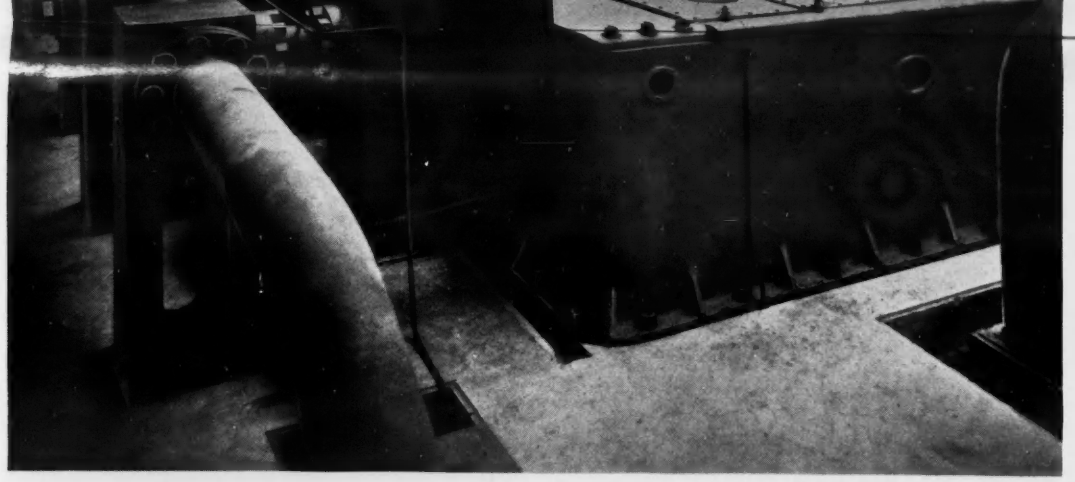

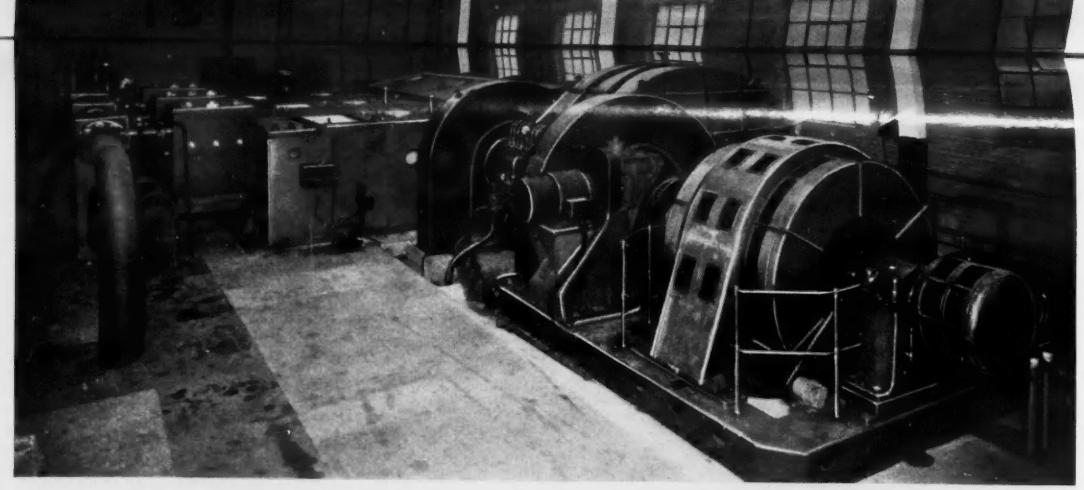

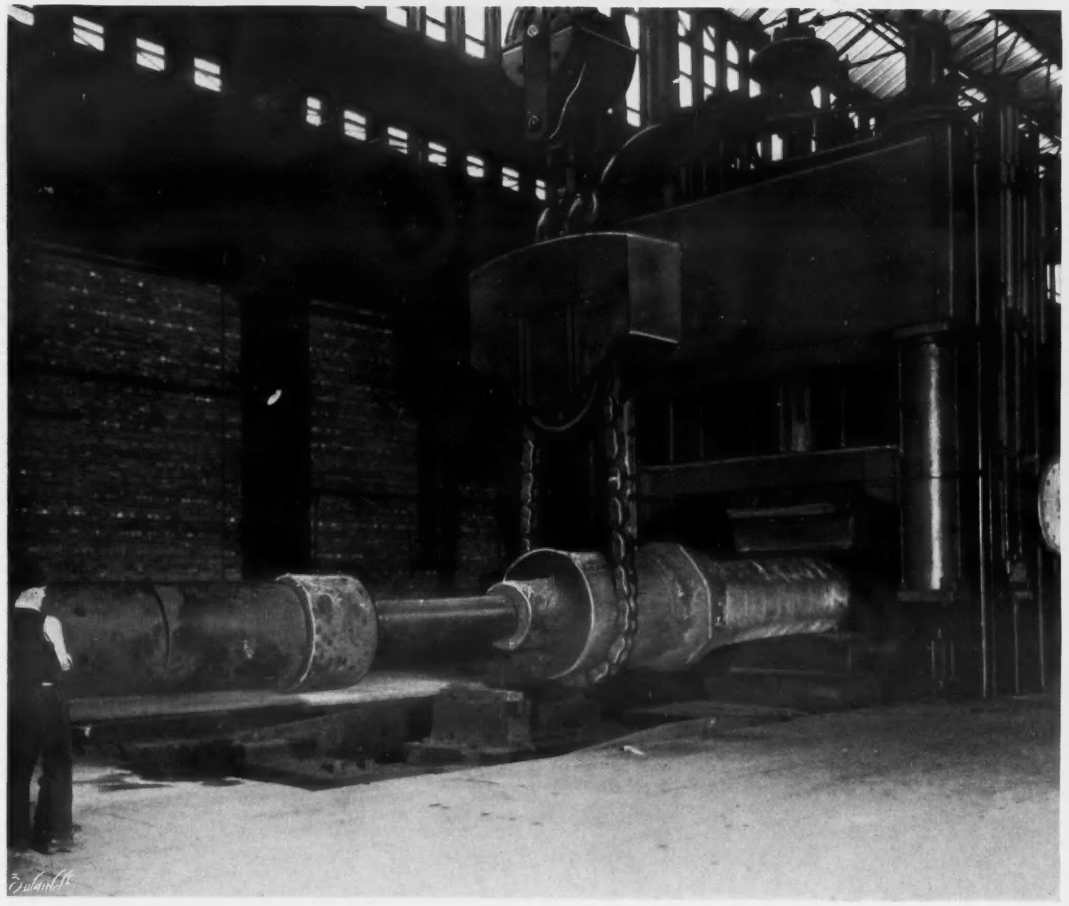

ABOVE:—WORKS SUB-STATION
CENTRE:—HYDRAULIC THREE-THROW PUMP
BELOW:—ROUGHING OPERATION UNDER 7000-TON PRESS

ABOVE:—GAS PRODUCER PLANT FOR RE-HEATING FURNACES
CENTRE:—MAIN PUMP-HOUSE FOR 7000-TON PRESS
BELOW:—CONTROL STATION OF PRESS

The Engineer

FEBRUARY 15, 1935.

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TWO-PAGE SUPPLEMENT—7000-TON FORGING PRESS AND ASSOCIATED PLANT OF THE ENGLISH STEEL CORPORATION, LTD., AT THE VICKERS WORKS, SHEFFIELD.

NOTICES TO READERS.

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THE TREATMENT OF BOILER FEED WATER.

THE weakening effect which elevated temperatures have upon metals maintained under stress seemed at one time to constitute a very serious objection to the use of extra high pressures and temperatures in steam power plants. Nevertheless in spite of the admitted or alleged dangers associated with the phenomenon of "creep" extra high pressures and temperatures have been adopted in a number of large modern power stations, while at sea important developments have taken place in the same direction. This weakening effect of high pressures and temperatures may be described as the mechanical aspect of the subject. From the great amount of attention which has been paid to it, it might be thought that it presented the only or at least the crucial practical item on the debit side of high pressure and temperature operation. At any rate after studying Mr. R. J. Glinn's recent paper before the Institution of Mechanical Engineers one feels that another aspect, the chemical, may be equally important and that it has been somewhat overshadowed so far by the mechanical aspect. It is certainly very desirable that the difficulties of a chemical nature encountered in the employment of high pressures and temperatures should be as clearly recognised and as accurately assessed as are those of a mechanical nature. At present our knowledge of the chemical aspect is far from being complete. Its extension presents important problems for the joint attack of the engineer, the chemist, and the metallurgist. Evidence indicating the importance of an early and thorough investigation of the subject is accumulating in the form of reports from certain high pressure stations regarding the difficulties experienced in the operation of their plants from actions of a chemical origin which occur within them. Mr. Guy's statement that troubles caused by the "carry-over" of deposits from the boiler have been known to reduce the output of 50,000 kW turbine plants to 45,000 or even 40,000 kW in the course of a month or so may appear a little sensational. Against it we may set the information received from Dr. Pearce that at the Battersea Station after a year's running no trace whatsoever of the trouble referred to by Mr. Guy has been found. In other respects, too, there is much conflict of evidence and opinion. Such conflict, however, does not lessen, but rather increases the necessity for a thorough study of the subject in all its complex bearings.

Troubles of a chemical nature originate in the constitution of the feed water make-up supplied to the boiler. They may make themselves felt in several different ways not only in the boiler proper but in the superheater and even—very seriously, it is alleged—in the turbine. They are of a complex character but at their root may be said to lie the fact that it is virtually impossible to command a continuous and constant circulation of perfectly pure water through a boiler, of water, that is to say, without a trace of any other substance, organic or inorganic, solid, liquid, or gaseous. It might be thought that in the evaporation and recondensation of the make-up water before its admission to the boiler we have a sure means of freeing it of all contamination. Theoretically distilled water ought to be pure but in practice various circumstances combine to permit the water delivered from the evaporator to carry with it sundry impurities in sufficient quantity to cause, in time, trouble in the boiler and beyond. Dissolved oxygen will not be eliminated by the evaporator and unless it is reduced almost to the vanishing point by subsequent treatment of the water in a de-aerator it will cause corrosion in the boiler. Again unless the evaporator is continuously and thoroughly cleared of the impurities deposited within it, its action may be accompanied by priming and with the onset of priming an uncontrollable amount of the impurities in the original water may pass over and appear in the evaporator condensate. Yet again the action of the evaporator on the impurities in the raw water may merely anticipate, without modifying, the action which would occur if the raw water were passed straight into the boiler. For example, if the water contains calcium or magnesium bicarbonate—the substances responsible for "temporary" hardness—the evaporator action will result in the liberation of carbon dioxide which, passing into solution in the condensed water, will render the make-up acid and corrosive. If, therefore, the raw water is impure—and from the boiler point of view all raw waters can hardly be otherwise—we cannot rely upon a process of evaporation for rendering it pure to the requisite degree. That the purity required increases with the pressure and temperature at which the boiler is operated is an accepted and well-established fact. The increased density of the steam at high pressures affects the physical conditions in which the impurities exert their harmful action while the intensity of the chemical reactions in which they take part is stimulated by the elevated temperature. It is for this reason that troubles of a chemical origin were surmountable with relatively little difficulty when pressures and temperatures were low and have become acute, and present new aspects, at the extra high pressures and temperatures now being adopted. Combined with the increase of pressure and temperature there has been an even greater proportionate increase in the rating of boilers, that is to say, in the quantity of steam generated per square foot of heating surface. This factor also enters into the problem and to it, perhaps, we may ascribe the chief responsibility for the harmful action of the impurities in the water being carried over from the boiler into the superheater and the turbines.

The difficulties to be surmounted are nicely balanced among themselves. On the one hand the raw water before being admitted to the boiler must be freed of any tendency to cause corrosion, whether by virtue of its oxygen, ammonia, or other impurity. On the other hand it must be deprived of those chemical bodies which, passing out of solution under the pressure and temperature conditions prevailing inside the boiler, would be deposited as scale on the boiler and superheater tubes and even, it may be, on the turbine blades. Since scale acts to protect the coated surface from corrosion and since corrosion implies, in general, access of the corrosive agent to an uncoated surface the two requirements are in a sense conflicting. In addition the steps taken to secure one may produce the very condition which it is desired to avoid under the other heading. For example certain treatments designed to mitigate the formation of scale involve the addition of sodium carbonate to the water or its appearance therein as the result of chemical reaction. This substance when exposed to the pressure and temperature of the boiler may decompose giving off carbon dioxide which will render the water acid and corrosive. The position is farther complicated by the necessity for avoiding treatments which will expose the metal parts of the boiler plant to the form of attack known as caustic embrittlement. It would appear that the treatment designed to avoid this phenomenon may accentuate the deposition of scale and encourage the carrying over of the deposition into the superheater and turbines. New methods of dealing with impure feed water are constantly being brought forward. In general, however, they aim simply at converting the harmful constituents into less harmful substances which remain in the water. The position seems to be that once water has been contaminated with chemical substances it is not possible on a practical scale and under practical conditions to cleanse it. We may change the nature of the impurities but we cannot by chemical treatment eliminate them. That proposition seems self-evident, but the establishment of its truth does not necessarily imply that it must always remain beyond our power to reach the ideal of chemically pure water for use in boilers. It may, however, mean that we shall have wholly to abandon purely chemical processes of treatment and to resort to mechanical, and possibly electrical, processes of achieving the desired end.

Railway Level Crossings.

WHAT, in our leading articles of December 7th and 28th last, we referred to as the Wormley level crossing is actually an occupation crossing carrying Wharf-road, on the west of the railway, from the village of Wormley to some market gardens and the river Lea on the east side. It was whilst crossing from the west side that a motor lorry was struck by an express passenger train from Cambridge to Liverpool-street. The locomotive and most of the carriages were derailed and the engine driver and fireman were killed. The report by Colonel Trench on the accident has now been issued. It reveals that there is a signal-box at the crossing, whose purpose is to operate the entrances to and exits from some loop lines; it has no control over the level crossing. It is the common practice, however, of a number of vehicle drivers to call out to the signalman and ascertain whether it is safe for them to pass. The railway was constructed under an Act of 1836, and in the book of reference the crossing is described as an "occupation road." Some fifteen to thirty vehicles use it daily to and from the market gardens. Local opinion is that it is actually a public road level crossing; but, as far as could be ascertained, no claim for status has ever been submitted to the railway company by any local authority concerned, and certainly no such claim has been accepted by the railway. Additionally to Wharf-road crossing there are a number of others on that section of the L.N.E.R., as to which representations were made to Colonel Trench at his inquiry. The situation is peculiarly difficult between the two adjoining stations of Broxbourne and Cheshunt—the former one mile to the north and the latter two miles to the south—as there is a narrow strip of land between the railway and the river Lea, with no north-south road and no outside communication except by level crossings over the railway. There are three public road level crossings, which are locked and attended to by gatekeepers, and no less than eight occupation crossings; one of the latter is never used, three have a light agricultural user, and the remaining four have a substantial user, including heavy lorries.

The present report opens with the observation that the occurrence from time to time of a serious accident, such as this, at a level crossing, tends to give rise to criticism, misunderstanding, and possible exaggeration of the dangers involved. Before proceeding further we think the point made in our two previous leading articles on this subject should be emphasised. That is, that railway companies have no specific legal responsibility for the protection of the users of occupation crossings. Such communications are provided for the accommodation of the landowner whose property has been separated by the construction of the railway, and the company's responsibility, so it has always been held, ends there. Recent information, the present report proceeds to say, supplied by the railway companies, shows that there are 4587 public road level crossings in the country, of which the great majority—4368—are provided with gates and controlled by the railway staff; the remaining few, mainly on railways and roads of minor importance, are provided with cattle guards, but are without gates and are unattended. The Ministry of Transport has no information as to occupation crossings, but it is estimated that the number is 10,000 or more. It is obvious that the standard of intelligence and care required to negotiate safely the average

occupation crossing is higher than that necessary at the great majority of public road crossings, where the vehicle driver has only to come to a stand when he finds the gates across the road. Colonel Trench refers to the practical measures mentioned in his Formby-Freshfield report. In particular, he endorses the recommendation that in cases of building development it should be the duty of the local authority to see that the lay-out embodies adequate and safe means of access for vehicles and pedestrians, without relying on the use of occupation crossings for such purpose. He now further advises that, as the majority of the vehicle drivers using such crossings are the employees or agents of one or two persons, suitable instructions or advice as to the use of the crossing could be issued by the railway company. Colonel Trench adds that he was informed, in the course of his inquiry, that legally a railway company would be able to object to the user of a crossing on a scale heavier than that which existed when the crossing was originally constructed and that actions on those lines were successfully contested in the Courts in 1902 and 1909. In two recent cases on the London and North-Eastern Railway the company, becoming aware of the prospect of a largely increased user of certain occupation crossings, has been able to prevent it by threat of an injunction. Finally, it is recommended that the companies should be asked to collect data, not available at present, as to the total number of occupation crossings in the country, classified as to their user, and that they be invited to consider, in the light of the reports on these two accidents, what practical measures are necessary for securing additional safety in future, and the means by which they should be brought into effect, in the interests of safety, and with fairness to all concerned. Meanwhile the control of the gates at Wormley from the signal-box is recommended.

It is necessary to come back to the cause of the Wormley accident in order to show the mentality of some drivers of motor vehicles. The man in this case was aware that the crossing was one requiring special caution; in fact, just before the accident he had had a conversation with one of the market gardeners and had then said so. He testified that in going to open the east gate he looked in each direction and again did so on his return. If that was true his looking up and down the line was of a very casual nature, as the signals are conspicuously visible and the up signals—which were "off" for the express—are at very short range. Subsequently to the accident the railway company put up a notice warning drivers to consult the signalman before crossing. Despite that, and notwithstanding the notoriety of the accident, a number of lorry drivers continued to cross without asking whether it was safe, and one such lorry was seen to cross the line about 50 yards ahead of an approaching train. As Colonel Trench remarks, "Such recklessness can only be attributed to the fact that a certain class of driver is prepared to take the same risks at a railway crossing as he does on the roads, when he can in most cases rely on the other man's braking capacity and he is presumably ignorant of the very different braking capacity of a train."

The Work of the River Trent Catchment Board.*

No. II.

(*Concluded from page 157, February 8th.*)

MAIN RIVER SURVEY AND COMPREHENSIVE SCHEMES: GENERAL.

THE essential preliminary to a comprehensive works scheme is a complete hydraulic survey which includes not only actual soundings, but complete sections of all the lands subject to flooding and also the computation of a mass of data germane to the problems involved, such as rainfall statistics ratios of "run-offs," flood levels, computed river discharges, and the like. The first intention was to make a systematic survey of the whole of the main river, but the lessons learned as the survey progressed enabled certain postulates to be laid down which dictated a change in the original programme. These can be summarised as follows:—

(*a*) That the area on the left bank of the river Trent lying between Mansfield and the river Humber is a distinct problem;

(*b*) That the area on the right bank of the river Trent between Gainsborough and the river Humber is also a distinct problem;

(*c*) That to accommodate the highest ascertained floods would require between two and three times the present river capacities and, therefore, the complete prevention of floods is a practical and economic impossibility;

(*d*) That certain areas of land, least subject to damage from floods, must be selected for flooding and used as "washlands" by arrangement with all affected parties, controlled flooding being thereby achieved;

(*e*) That urban areas should receive special consideration for protection against flooding.

These postulates having been established, it became possible eventually to commence evolving two major schemes in conjunction with the survey, namely, the Nottingham flood alleviation scheme and the Keadby pumping scheme, detailed references to which are made later.

(*a*) *Main River Survey: Tidal Reach.*—The May, 1932, floods made it apparent that the preparation of flood alleviation schemes should no longer be delayed and, as an initial step, the Main River Survey Department was established in July, 1932, with a special staff of engineers. It was found possible to develop the study of flood conditions, and it was established that actual danger to flooding from the river Trent in its lowest tidal reach was only from abnormally high tides; that a "fresh" in conjunction with high tides did not materially enhance them; but that the height of the low-tide level was materially affected, so much so that, in all cases, the pointing outfall doors of the numerous drains either only opened for short periods or were sealed entirely for many consecutive days. This meant that the normal gravity discharges were arrested and the local run-offs had to be stored, resulting in serious flooding over the low-lying lands.

(*b*) *River Gauging.*—The realisation of the importance of the low tide levels as affecting drainage and the high tide as a source of danger to the embankment led to the erection of twenty gauging stations at approximately 2-mile intervals extending from Carlton to Adlingfleet. These, with the Cromwell Lock gauge, enabled the whole tidal range of the river to be effectively gauged by means of a gauge-reading organisation which provided for synchronous readings by selected men who sent in returns on printed forms, together with particulars of directions of flow, direction and strength of winds, height of ægir, and so forth. The automatic level recorder offers a practical means of obtaining this information, but although there are a variety of makes on the market, not one has yet been devised to surmount the warp nuisance, which practically eliminates the "float" recorders from consideration. By experiment, however, it has been found that a form of pressure recorder is giving promising results, and with further trials it is hoped eventually to devise a thoroughly satisfactory and reliable instrument.

(*c*) *Northern Area: Proposed Pumping Scheme.*—The original intention, when the survey was contemplated, was to carry on throughout the whole of the main river. As the work proceeded, however, the knowledge gained made it apparent that, apart from the influence of "fresh" on low tide levels, the drainage of the northern area lands, *i.e.*, the lands drained by the rivers Ryton and Idle and those further north on the left bank, and the land north of Gainsborough on the right bank, presented problems independent of the remaining area of the Board. It was decided, therefore, to suspend the actual river survey when the tidal reach had been completed in order to concentrate on an investigation of the northern area lands whilst the survey staff were still centred on Gainsborough.

A study of old histories showed that the main defect of the whole drainage system (that of drainage into the river Trent at places where the low tide levels are seriously affected by "fresh") had been recognised by the engineers Rennie and Leather, both of whom strongly advocated a return to natural drainage lines, entailing the construction of a channel to discharge in the neighbourhood of Adlingfleet, where the outfall is unaffected by the river Trent when in flood. In consequence, investigations into the feasibility of such a channel were made, including special longitudinal and cross-sectional surveys of the lands and existing channels that might be utilised. The scheme was finally abandoned by the consideration that, even if the existing gradient were just sufficient, there is the knowledge that, probable subsidence in the future would render the gradient still worse, and ultimately cause the channel to cease to function. Moreover, estimates of the cost of the project reached such a sum that any improvements would have been attained at a price beyond economic considerations. It was realised, therefore, that, as the question of future subsidence played such an important part in the evolution of a comprehensive scheme, the only practical solution lay in the utilisation of a system of pumping which could always be developed to overcome this difficulty, and the Keadby pumping scheme is now in process of preparation.

(*d*) *Floods.*—Three general floods have occurred since the constitution of the Board, namely, the August-September, 1931, flood, the May, 1932, flood (which was definitely a major flood), and the February-March, 1933, flood.

Referring briefly to the 1932 flood, there can be little doubt that it was the most serious since the great flood of 1875 and in some places actually exceeded it. The actual area of land submerged is computed at 150,000 acres, and, including areas which suffered from waterlogging, the total area affected was approximately 374,000 acres. The resultant damage was, of course, considerable, although no actual assessment could be made; but although grass lands recovered, except where they were temporarily ruined by polluted water, the arable lands suffered severely, particularly in respect of potato and other crops. Whilst the 1932 flood was not the worst on record, there can be little doubt that it was the most destructive ever known, simply because considerable areas of lands liable to flooding have been urbanised and built upon since the last great flood. The losses sustained to properties of this nature are not limited to actual material damage to buildings and plant, but there is also the interference of business to be considered by the temporary closing down of factories, to say nothing of the disorganisation of railway, road transport, and public services, and the danger to the health of the community. As an aftermath of these floods, resolutions were received by the Board from various local authorities urging that remedial measures should be put in hand forthwith. It was generally alleged that the floods were enhanced by the presence of numerous obstructions in the rivers, the subsequent clearings of which have been referred to elsewhere in this report. A photograph of a flooded place is reproduced in Fig. 7.

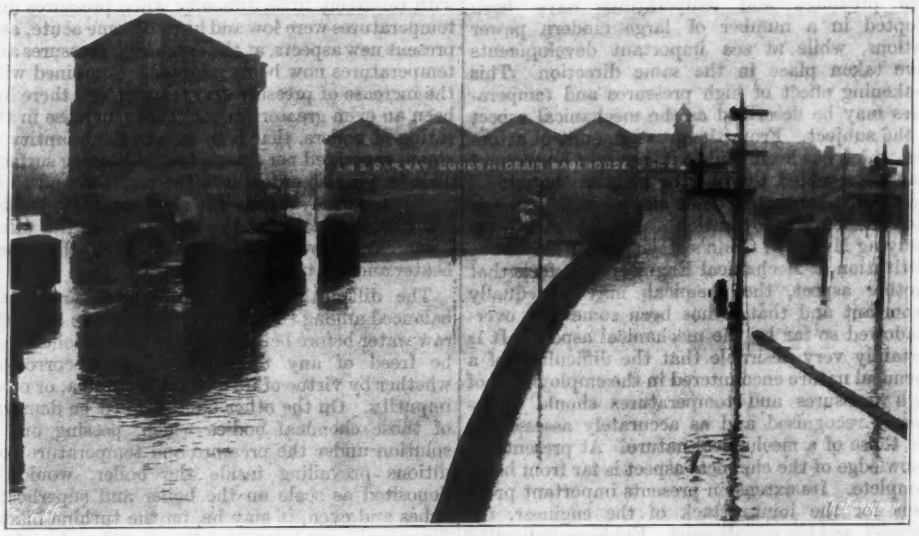


FIG. 7—L.M.S. RAILWAY STATION AT NOTTINGHAM IN MAY, 1932

The third flood, that of February-March, 1933,

* Abstracts from the Triennial Report of the Board for the period ending October 31st, 1934.

found the Engineer's Department better prepared and equipped with technical assistance to take advantage of the situation. Velocity readings were taken at selected places on the river Trent to enable accurate discharge curves to be plotted, whilst a mass of flood data was collected first hand, and special observations made of the behaviour of certain difficult rivers, such as the rivers Idle and Torne. At this stage it was established that, whereas the northern area would have to be treated as a distinct problem in the preparation of a comprehensive scheme, Nottingham and district formed a key position and represented the lowest of a series of large urban areas which suffer materially from flooding. It was therefore decided to divide the river Trent below Nottingham into three divisions for the purpose of study as follows :—

(1) The tidal reach from Trent Falls to West Stockwith ;
(2) The tidal reach from West Stockwith to Cromwell Lock (the end of the tidal reach) ;
(3) The non-tidal reach from Cromwell Lock to the Holme Locks, Nottingham.

The flooding from the river on to the adjacent lands is different in character in each of the three reaches, *i.e.*, the first reach is only subject to tidal inundation, the second to a combination of both tidal and fluvial waters, the third from fluvial waters only.

The works involved in both the second and third sections are of considerable magnitude and would take many years to complete, although they could be commenced in the comparatively near future, but as it has been accepted that the important urban areas should receive early consideration, the key position at Nottingham has been explored in detail and a scheme evolved which is to be considered by the Board.

The Nottingham scheme can now be set out briefly as follows :—

(1) The construction of an embankment system on the south bank to the river from high ground near the Fairham Brook as far as the Suspension Bridge. This will exclude river water from the residential districts of Wilford and West Bridgford.

(2) The construction of flood gates and a small embankment near Castle Boulevard to prevent water flowing *vid* the Nottingham-Beeston Canal towards the city.

(3) Owing to the fact that such embankments would, unless precautions were taken, tend to cause a slight increase in flood level over unprotected areas above Nottingham, it is necessary to accelerate the flow through the present embanked river channel from the Suspension Bridge to the L.M.S. Railway Bridge north of West Bridgford. Widening and deepening this reach being impracticable, the increased flow can only be obtained by increasing the slope, which in turn is provided for by decreasing the flood level at the L.M.S. Bridge by means of a by-pass channel, to be cut on the south side of the river from this point to below the Lower Holme Lock. In order to maintain the existing normal river level for navigation purposes the by-pass channel will be controlled by a battery of radial sluice gates near the Holme Cut. Bridges will be provided where necessary to allow access, and to ensure continuity of the towing path. The construction of a by-pass channel is to be preferred to the possible alternative of increasing the capacity of the river channel by widening and deepening, for the reason that any such interference with the natural *regimé* of a river inevitably leads to shoaling and silting, the river tending to return to the *status quo* as soon as possible.

Detailed plans and estimates for the Nottingham flood protection scheme have been prepared, and a number of quotations received from contracting firms. Bore-holes have been sunk to test the strata, and to ascertain the levels of the Keuper Marl, on which the civil engineering structures will be founded. Future consideration of the scheme stands referred to the General Purposes and Works Committee of the Board.

(*f*) *Rainfall and Run-off.*—Another branch of study to which considerable attention has been given is rainfall over the catchment area and its relation to the flow in the river. This question of the relation between rainfall and run-off has caused more controversy than perhaps any other subject in hydraulics. Numbers of different investigators and hydrologists have put forward theories and introduced formulæ, the object of which is to enable the probable maximum run-off from catchment areas to be calculated. Several of these formulæ are in common use, but it is seldom that any two formulæ will give results that do not differ widely from each other. It is clear that there is much room for further investigation of this fundamental problem, and Catchment Boards would appear to be the authorities best able to devote attention to the matter. The run-off from the River Trent catchment area above Nottingham is therefore in process of being analysed and studied.

Obstructions in Watercourses.

Weirs.—Obstructive weirs may be classified as (*a*) those of the solid high crest level type and (*b*) those fitted with inadequate sluices. They are both obstructive to the flow of the river in that they enhance the water level and in flood times cause the water to mount up so that it flows in a series of steps, frequently flooding, and certainly waterlogging, the adjacent lands unnecessarily. There are some ninety-seven weirs crossing the various main rivers, most of which are inefficient, and the acquisition for reinstatement of these structures presents a fruitful source of beneficial work for the future. It may be mentioned here that it is not desirable to remove weirs wholesale from the rivers, even if such matters as water rights could be ignored. Weirs, adequately sluiced, cease to become obstructions and are necessary for the conservation of water, not only in regard to navigation, milling, irrigation, and fishing, but in the interests of land drainage itself, because the emptying of rivers in drought periods merely converts the river beds into ideal breeding grounds for rank vegetation, to say nothing of mosquitoes.

FIG. 8—SNOW SEWER OUTFALL SHOWING WARP DEPOSIT

Bridges.—Considerable misapprehension exists regarding suitable dimensions for bridges spanning watercourses. It is important that the invert levels should not be above the gradient line of the river bed itself, that the headway should be well clear of flood level and in a lesser degree that the cross-sectional area of discharge should equal that of the river above and below. A bridge can be narrowed in span providing the bank lines of approach and departure are well designed, as the amount of "hold up" is not considerable. On the other hand, a bridge with an opening too great merely retards the velocity and thus is the means of forming shoals, both above and below. If the surrounding land is liable to floods, the bridges should be provided with relief arches to pass through the flood waters.

Banks.—Obstructions on banks vary in character, and consist of wharves and buildings which obtrude into the fairway, such as the Old Mill at Beckingham, which was purchased for removal. Buildings in berms or bights, *i.e.*,, lands between the natural and flood banks, are not uncommon, but these in future will be controlled under the by-laws when confirmed. The river Idle offers another form of obstruction, which consists of lateral banks constructed across the wide berms and thereby nullifying all its washland advantages.

The Doncaster Rivers and Works Thereon.

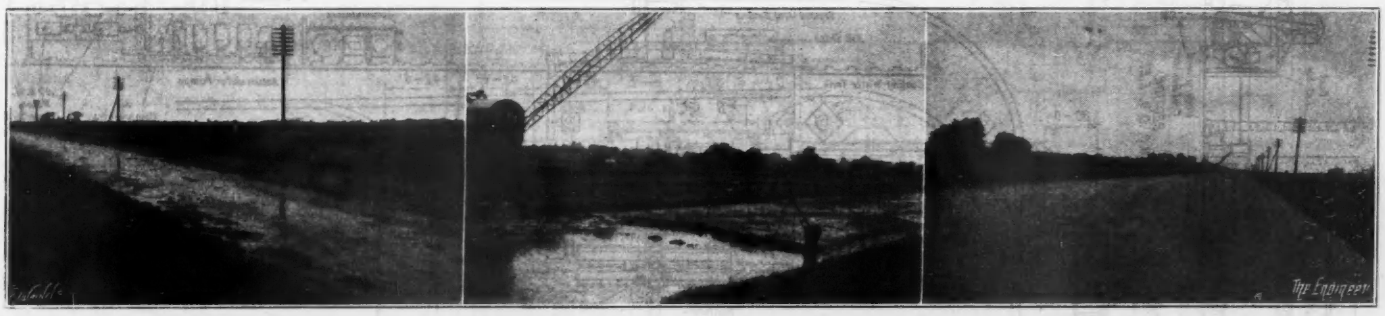
With minor exceptions, all the rivers are flood banked, and, when it is pointed out that the alluvial soil through which they pass is mostly of a sandy and peaty nature with an almost entire absence of clay, it will be appreciated that the banks, which are largely composed of local material, are in a poor condition generally and require constant maintenance. Further, the rivers have a very flat gradient with a minimum scour velocity, with the result that deposits on the beds are a common feature and much dredging is required throughout.

All these rivers discharge by gravity into the river Trent, and they are rendered non-tidal by the timber automatic pointing doors at the various outfalls which close when the tide commences to rise. They are also fitted with slides or sluices to maintain water level in the channels during dry periods. This type of door, although excellent in many respects, is not able to prevent a certain ingress of tidal water on the first of the flood, and the leakage consequently causes a deposit of warp, which has to be cleared from the bed by a process of "babbing."

In all, there are eight outfalls—the river Torne having two—usually consisting of two sets of double-leaf doors, and the photograph—Fig. 4 (*ante*)—of the Hatfield waste drain outfall showing landward elevation, gives an idea of the general arrangements.

Whilst the outfalls generally are in need of attention, those of the Snow Sewer and North Soak Drain have given particular anxiety. In the case of the Snow Sewer an increasing inflow from the river Trent was observed during high-tide periods, which proved that the structure was seriously undermined, while cracks in the heavy masonry arches indicated inevitable collapse if the situation were neglected. The necessary underpinning work has now been completed. Fig. 8 indicates the considerable deposit of warp in the drain caused by the leakage. With regard to the North Soak Drain outfall, the doors have been found to be seriously strained, and, not closing properly, they permit a great deal of river Trent warp to enter the drain, necessitating extensive "babbing." The work of repairing the doors will be difficult, because their situation under the road and railway siding is most inaccessible, while the forest of timber immediately in front of the doors further complicates the position.

Adverting to bank work, this has been confined to the weakest places in the flood banks and slips in the natural banks within the money available. The river Torne banks can be described as consistently weak, and will always be a source of danger until the comprehensive scheme for dealing with the northern area has been effected. During flood periods the river Torne does not actually overflow its banks because they are so porous that the water steadily seeps through during the high water level period, resulting in flooding of the adjacent lands just the same. Regarding dredging activities, these have been confined up to date to the river Torne, where two excavators are now employed. The 50ft. jib excavator, transported from the river Idle on completion of the dredging and bank work in its tidal reach, has proved most useful in the lower reach, where, although operations can only be carried out from one bank of the river, the bucket can, nevertheless, be thrown effectively across the stream to the further bank. Photographs Figs. 9, 10 and 11 give an idea of the silt which is being removed, beneficial results being already apparent.



FIGS. 9, 10 AND 11—CONDITION OF RIVER TORNE, BEFORE, DURING AND AFTER DREDGING

On the morning of September 1st last there was a collision between a passenger train from Ashford to Margate and a goods train, which was standing, with its engine towards Ashford, just outside that station, waiting to enter some sidings off the Margate line. The signalman had made all the movements that had admitted the goods train on to the branch, but in the ten minutes that had elapsed after that train had come to rest, he was engaged on other work and forgot it, and thus when the passenger train was offered he accepted it, lowered the signals, and the collision followed. That, however, should not have happened, as the line is protected by Sykes' lock-and-block, whereby the goods train should have passed the starting signals, 160 yards beyond the siding points, and deflected an electrical treadle there before the signalman could have sent train-out-of-section for the goods train and accepted the passenger train. Under the conditions that prevailed, wherein the train would have gone into the sidings, and so would not have passed the starting signal nor deflected the treadle, a releasing key was provided to unlock the instrument. It is the opinion of Colonel Trench, who inquired into the accident, that the signalman, though he denied using the key, unconsciously did so. The provision of a releasing key, he says, is unfortunately a necessity for the practical working of the Sykes' lock-and-block system. The valuable safeguards afforded by this system can be neutralised by the improper use of the key, and it is necessary to rely upon the signalman to bear in mind that the use of the key is only justified in certain circumstances and to assure himself, prior to use, that such special circumstances exist.

A New Forging Press and Plant.

THERE has just been installed in the Vickers works, Sheffield, of the English Steel Corporation, Ltd., a new 7000-ton hydraulic forging press and associated plant, and we recently accepted an invitation to inspect it. The plant is intended for, and is now engaged upon the production of heavy forgings, such as hollow steel vessels up to the largest sizes and weights required for use in chemical and oil engineering processes and power plants under conditions of high temperature and pressure, for autoclaves, gear wheels and rims, large electrical rotors, marine crank shafts, and many other heavy parts which could not be handled at all or only with difficulty by a smaller plant. The installation of the press and its associated equipment forms a part of the reorganisation and re-equipment scheme, estimated to cost about 1½ million pounds, and financed by Vickers, Ltd., which the firm has nearly completed.

It is now over fifty years since the first hydraulic forging press was erected in the Vickers works, and up till January of this year that plant was still in operation. It had a single hydraulic cylinder, 40in. in diameter, and was capable of exerting a pressure of well over 3000 tons. It was driven by a double-cylinder steam pump with a maximum hydraulic pressure of 2½ tons per square inch, which delivered water at the rate of 190 gallons per minute. The new electro-hydraulic pump serving the 7000-ton press delivers 1432 gallons per minute at the same working pressure. The difference between these two figures will give some conception of the advance that has been made in the design and operation of forging plant in the intervening fifty years.

On entering the press house one of the first impressions to be received is that of light, for many of the older forges are not by any means remarkable in that respect. Then it is realised that the place is lofty and spacious. So much so, in fact, that the real magnitude of the dimensions of the press itself is not revealed until a closer approach has been made. Sir William Arrol and Co., Ltd., were the contractors for the building, which has been erected against the outer wall of what is now termed the medium forge. It has a length of 415ft., a span of 76ft., and a height to the eaves of 60ft. Two cranes run on gantry rails 44ft. above floor level, spaced 70ft. apart. Against the wall furthest from the medium forge, as will be seen from one of the line engravings, there has been erected a range of reheating furnaces of various capacities, and at one end there is now in course of construction an annexe to contain a further group of furnaces. A photograph reproduced on page 174 gives an excellent impression of the appearance of the building and the press itself, while other engravings in a Supplement to this issue show in more detail some of the plant. At night the shop is lighted from correctly spaced reflector fittings utilising high-power gas-filled lamps, which are suspended from the roof trusses, and by angle type fittings placed at a lower level around the press itself. The electro-hydraulic pumping plant which supplies the 7000-ton press is housed in an annexe to the main building close to the press, and is illustrated by engravings in the Supplement.

The 7000-Ton Press.

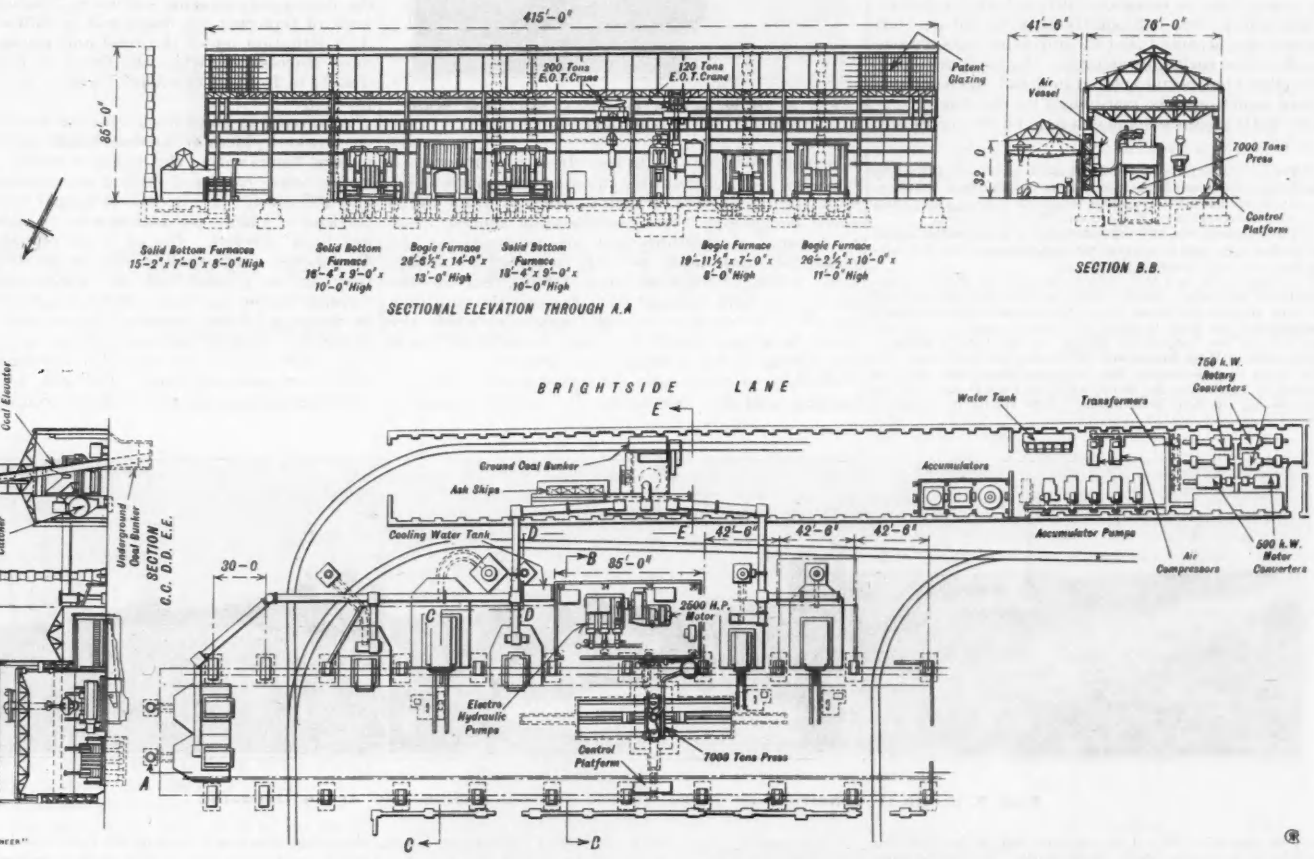
It is believed that the 7000-ton press is the largest machine of its kind in the world to be operated by a high-pressure electro-hydraulic pumping set. Its single-cylinder forging ram has a diameter of 60in., with a stroke of 102in., and the normal working pressure of the hydraulic fluid—water mixed with a greasy compound to prevent rusting of the parts with which it comes in contact—is 2½ tons per square inch. Under these conditions a total net forging pressure of 7000 tons is exerted, and a penetration speed of 2in. per second is attained. The capacity of the press is perhaps better expressed by noting that ten 5in. penetration strokes are given per minute at full load or a greater number at smaller penetrations or, alternatively, greater penetrations at fewer strokes. The ram is returned by two hydraulic lifting cylinders, each 17in. in diameter, one on each side of the press, which are supplied with water from an accumulator at a pressure of 1 ton per square inch. These cylinders lift the main ram at the rate of 5in. to 6in. per second. Between crosshead and anvil plate the press has maximum daylight of 17ft. 6½in., and the corresponding distance between the 26in. columns is 16ft. 6in. All the main press forging motions are operated from a single master control or "handing" lever at the control station beside the press, a "clock" on the side of the press informing the forge master of the depth of each penetration. The maximum pressure and speed of the press can be limited by an adjustable choke valve which allows any water in excess of the amount required to be returned directly to the air vessel on the suction side of the main pump. This device also allows the press to be used as a vice, all the water under such conditions being short-circuited, so that the ram has no movement. The choke valve is controlled through a telemotor gear by an auxiliary lever on the control platform. Other levers at the same place control auxiliary hydraulic gear for the manipulation of work, tool changing, &c. Any surge in pressure that may occur in the pressure pipe line, owing to the operation of the press or for any other reason, is damped out by a large spring-loaded hydraulic shock-absorbing valve in the pump house. Other safety devices arranged in the pressure circuit include a multiple spring-loaded relief valve, which opens at a pressure of 2·75 tons per square inch, and short-circuits the pump water back to the air vessel. This valve would operate if the press ram for any reason encountered an excessive resistance, and it thus protects both the pump and the press from damage. In the unlikely event of its failure to operate, a secondary safety device automatically returns the "handing" lever to the "off" position. Safety relief valves are also fitted in the accumulator pressure pipe line to the lifting cylinders.

The Pump House.

The pump supplying the press with high-pressure water is of most unusually large size, as will be seen from two tone engravings in the Supplement and the drawing reproduced on page 179. Before deciding upon a straightforward three-throw single-acting design, much consideration was given to the possible advantages of other constructions, such as duplex pumps, double-acting and multi-cylinder types. But the balance of advantages was found to lie with the simpler design eventually adopted. The equipment was designed by Vickers-Armstrongs, Ltd., Elswick, to the requirements of the English Steel Corporation, Ltd., and the pumping set was made at Elswick, Newcastle-upon-Tyne. The necessary gearing between the motor and pump was made at the Barrow works of Vickers-Armstrongs, Ltd., and the driving motor, together with the required switchgear, was supplied by the Metropolitan-Vickers Electrical Company, Ltd. Complete, the equipment weighs about 400 tons.

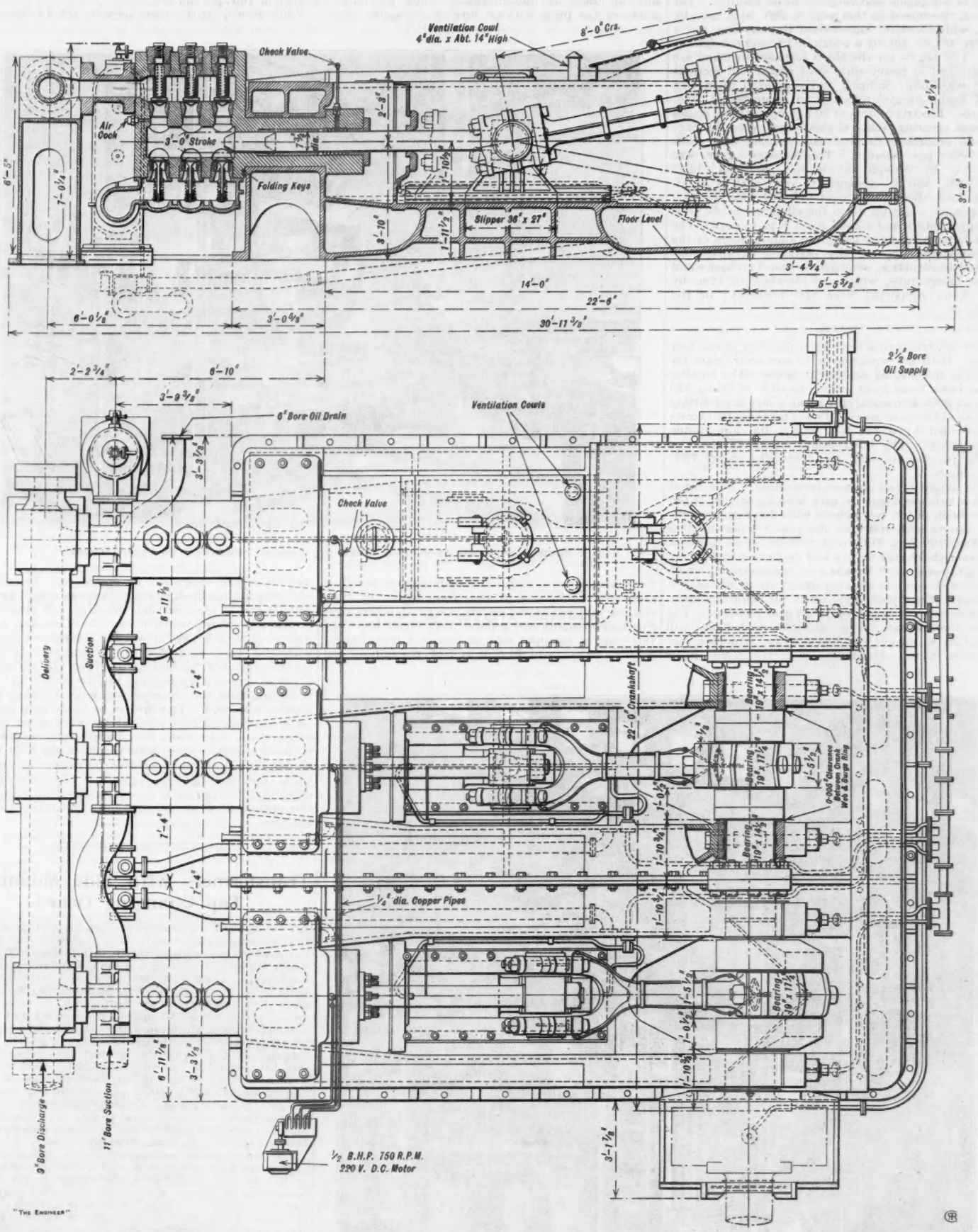
The horizontal pump has three single-acting stainless steel rams, 7¾in. diameter with a stroke of 36in. It runs at a maximum speed of 84 r.p.m., and at that speed delivers 1432 gallons of water per minute. It is driven by a 2500 b.h.p., 6600-volt, three-phase, 50-cycle, slip-ring induction motor running at 600 r.p.m. synchronous speed, through totally enclosed double-helical gearing, giving a speed reduction of 7 to 1. To meet the peak load condition, which may reach a demand expressed in horse-power at a figure of 6500, two high-speed fly-wheels are mounted on the pinion shaft and are brought into operation by an electrical slip regulator of the type used in conjunction with Ward-Leonard rolling mill drives, which allows the speed of the motor to be temporarily reduced. All the rotating and reciprocating parts of the pumping unit are enclosed; the bearings and slides are force lubricated; and the gear teeth are lubricated by spray. The lubricating pumps, which are situated in basements at each side of the main pump, are driven from it through chains, vertical shafts, and bevel gears. Stand-by electrically driven pumps are also provided and a horn and lights give warning of any failure. Arrangements are made for continuous observation of the running conditions.

The pump is built up of three similar body units, which are combined with the valve chambers. The latter are forgings having all chambers bored out of the solid, and are fitted with stainless steel suction and delivery valves. The crank shaft is arranged in



ARRANGEMENT OF 7000-TON PRESS AND ITS ASSOCIATED PLANT

THREE-THROW PUMP FOR 7000-TON FORGING PRESS



three single throws, each of which is carried in its own pair of bearings on one unit of the bed-plate framework. The crank pins and journals have a diameter of 19in., and run in white metal-lined bearings. Forgings and castings for the pumps were made by the English Steel Corporation, Ltd.

The plant operates on a closed air vessel system. The air vessel acts as a prefiller for the main press cylinder, receives the exhaust water from this cylinder, supplies the suction side of the pump with low-pressure water, and receives the low-pressure water from the delivery side of the pump when it is circulating under light load conditions. Compressed air from the service mains maintains the pressure of the water in the air vessel between a minimum of 55 lb. per square inch and a maximum of 70 lb. per square inch. In order to keep the circulating water as cool as possible, the water storage capacity of the air vessel is at least ten times the main press cylinder capacity.

SUB-STATION.

The electric supply for operating the main pump motor and auxiliary motors is taken from the works sub-station close by—see the first line engraving. This station is fed with 6600-volt, three-phase, 50-cycle current from the main works power station, and it is equipped with the necessary transforming and converting plant for supplying A.C. and D.C. at 540 volts and 220 volts. In the sub-station there are five pumping sets—one a stand-by—which supply water to three accumulators with a total storage capacity of 750 gallons. It is from these accumulators, in which the pressure is maintained at 1 ton per square inch, that the water for the operation of the main press ram-lifting cylinders and various auxiliary hydraulic motions is drawn. Use is also made of this water in the medium forge. Four accumulator pumps working together deliver water at the rate of 400 gallons a minute.

REHEATING FURNACES.

For the supply of the reheating furnaces there has been erected close to the heavy forge a producer gas plant installed by the International Combustion Company, Ltd. This plant is almost automatic in operation, and is fitted with numerous recording devices by the observation of which the constitution of the gas may be maintained constant and the quantity supplied can be adequately controlled. The reheating furnaces themselves will eventually be seven in number, of which five have already been installed.

They were supplied by Wincotts, Ltd., and when the plant is complete there will be four fixed-bottom furnaces and three bogie furnaces serving the press. They are of different sizes to suit the differing dimensions of the ingots and forgings to be handled. The largest, illustrated on this page, is 28ft. 6½in. long by 14ft. wide by 13ft. high, while the smallest has a length of 15ft. 2in. by a width of 7ft. and a height of 8ft. The bogies for the three furnaces so fitted are constructed of heavy mild steel plates and sections lined with 15in. firebrick and supported upon cast steel double-flanged rollers, 12in. diameter at 30in. centres. Electric motors of 50 h.p. operate the bogies through gearing and chains, and give haulage speeds, according to the load, ranging from 20ft. to 30ft. per minute. The haulage gear was supplied by Joseph Booth and Brothers, Ltd., of Leeds, and is designed to deal with a maximum load—bogie and ingot—of 300 tons at 20ft. per minute. Lift-up doors for all furnaces are electrically opened and closed by 3 h.p. motors. The solid bottom furnaces have also sliding doors of the hinged type, supported by carriages of mild steel riveted construction, arranged to travel on upper and lower bridge rails, which are attached to 12in. by 6in. joists supported from the buckstays of the furnaces.

CRANES.

Two electric cranes have been installed in the new forge. Both are equipped with turn-over gears for rotating the forging under the press. The smaller crane has a main hoist motion capable of lifting 120 tons at 20ft. a minute, and an auxiliary hoist lifting 40 tons at the same speed. Power for these two hoists is provided by a 325 h.p. and a 100 h.p. motor respectively. The longitudinal travelling speed is 120ft. per minute and the traversing speed 70ft. per minute.

The larger crane is more interesting. It is fitted with a two-speed gear to give hoisting speeds of the main hook of 9ft. per minute with 200 tons, or 18ft. per minute with 100 tons, the power being supplied by two 100 h.p. D.C. motors running in parallel. Between the electric supply and the hoist motors there is interposed a "Metadyne" transformer, which supplies the motors with constant current at variable voltage. The system gives much the same flexibility of operation as a steam-operated gear possesses. The crane motors may, for instance, be stalled and still maintain a torque without damage. Another particularly useful advantage is that the crane driver can easily so adjust his controls that just sufficient torque is exerted at the motor pinion to balance that due to the weight on the crane hook. The load is thus supported independently of the brake, and the crane will automatically follow the movements of the press without further assistance from the crane driver. From the maintenance point of view the elimination of the usual contactor type starting and regulating panels is a great advantage. For tool changing and general work about the forge this crane is equipped with an auxiliary hoist having a lifting capacity of 40 tons at 20ft. per minute and driven by an 80 h.p. motor. The crane has a longitudinal travelling speed of 120ft. per minute and a cross traverse at the rate of 50ft. per minute. The turning gear is operated by a 30 h.p. motor driving a chain at 16ft. per minute.

While we were at the works we were able to observe the plant just described in operation. The ease with which it could all be controlled was very impressive, and it is obvious that the firm now possesses in this new plant, which is capable of dealing with ingots up to 250 tons in weight, a forge consonant with the most up-to-date requirements. It was encouraging, too, to find so many of the reheating furnaces occupied by forgings and to be told in conversation that the demand for large forgings has greatly increased. The firm is to be congratulated on its courage in that even at the very worst time of the trade depression, now happily passing away, it was decided to erect new plant which, if it was to pay its way, must necessarily be worked at something approaching full capacity. The increased demand for forgings is a complete justification of the optimism of those controlling the activities of the firm.

AUTO-SLIP REGULATOR AND MAIN OIL CIRCUIT BREAKER IN PUMP HOUSE

200 TONS CAPACITY BOGIE RE-HEATING FURNACE

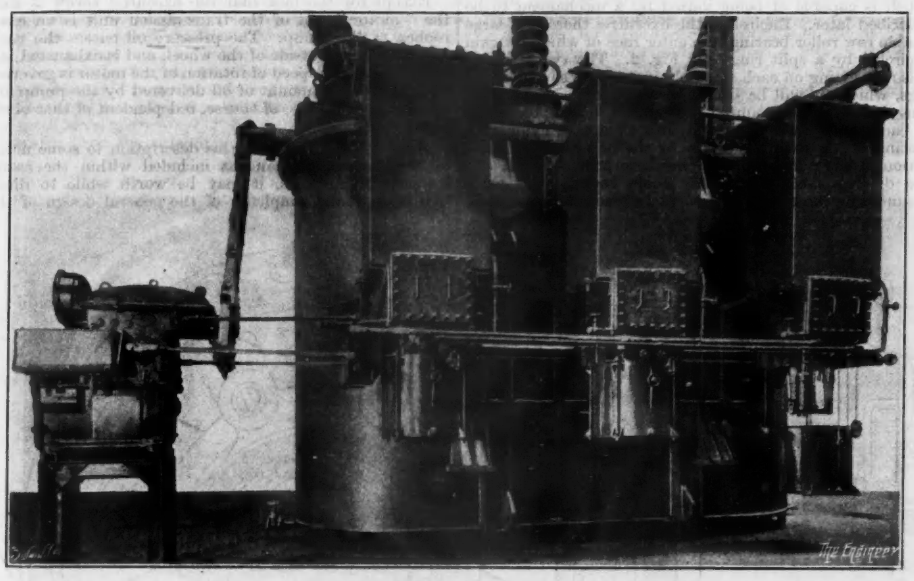
Transformers with Side Mounted Tap Changing Gear.

Two 20,000-kVA, three-phase, 50-cycle, 132/33-kV. star/delta-connected transformers incorporating new features have been supplied by the British Electric Transformer Company to the order of the C.E.B. for service at Eastbourne. Both units are fitted with the makers' latest type of "on-load" side-mounted tap-changing gear. From each phase the high-voltage tappings are connected to a specially designed selector switch with two bars, and brushes which can connect the bars to adjacent taps or alternatively both bars to a single tap. The two bars are each connected through half the winding of a split balancer to two oil diverter switches which divert the load current before any movement is made on the tapping selector switch, which, as usual, can only operate when no current is passing. In accordance with the usual practice, the diverter switches operate in separate oil tanks, so that any sparking that may occur cannot contaminate the oil in the main transformer tank.

The tap changing mechanism may be either power operated from a remote control point or manually operated on site, the change over from one method to the other being made by means of a clutch lever, which may be padlocked in the neutral or in either of the other two positions. The power unit to be seen on the left of the accompanying illustration drives the three selector switches in the main transformer tank through a chain, and through external cranks and rods, the tripping and closing mechanism for the three diverter switches, the separate drives from the unit being arranged to give the correct operating sequence. The chain for transmitting motion to the selector switches is housed in a weatherproof casing containing an oil bath. Two jockey pulleys serve for adjusting the chain tension to ensure smooth running. As the selector switches are at the top of the transformer tank, by removing covers on the tank lid they may readily be inspected.

The three rectangular tanks, bolted on the side of the main tank, house the "auto balancers," connections to the main transformers being made through oil-tight terminal bushings, and in the event of it being necessary to inspect the balancers only a comparatively small quantity of oil need be removed from the balancer tank concerned to allow the removal of an inspection cover and access to the terminals for disconnecting. The diverter switches are suspended from each auto-balancer chamber and

are completely accessible from ground level. They have drop-down tanks, lowered by a winch fitted on the end switch. Each tank is fitted with an explosion diaphragm and an oil level gauge, while an independent silica-gel breather supplies dry air to all three switches. The tripping gear is contained in a box on the end diverter switch, and in the unlikely event of failure of the diverter switches to operate, an electrical interlock between the tripping mechanism and the power unit breaks the motor circuit, thereby stopping the entire mechanism and preventing the possibility of breaking the load current on the selector switches.

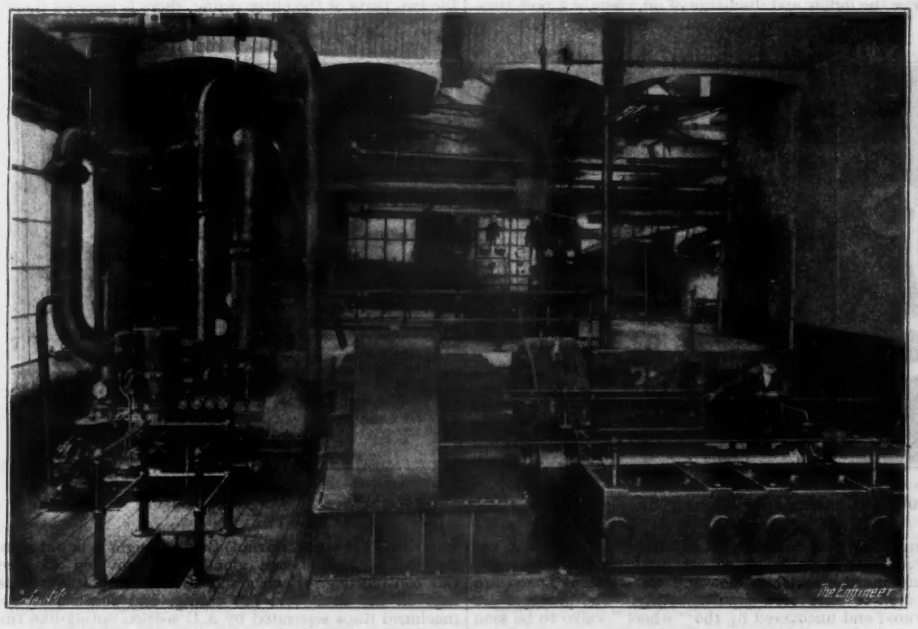


TRANSFORMERS WITH SIDE MOUNTED TAP CHANGING GEAR

A Paper Mill Electric Power Plant.

IN the Rishton paper mills of A. M. Peebles and Son (1927), Ltd., a B.T.H. turbo-generator, shown in the accompanying illustration, has been installed to take the place of a reciprocating engine. The turbine is of the extraction type, with self-contained surface condenser and auxiliaries, and is rated at 1250 kW, at a speed of 6000 r.p.m. It is coupled through B.T.H. double-helical reduction gears to an 850-kW, 260-volt D.C. generator, which runs at a speed of 800 r.p.m., obtained from the first reduction, whilst the second reduction, which gives a speed of 110 r.p.m., serves for driving the mill mechanically through a flexible coupling. The steam conditions are 160 lb. per square inch and 650 deg. Fah. total temperature. Two extraction points are provided. One normally supplies steam at rates up to a maximum of 2500 lb. per hour, and as this tapping point is uncontrolled the pressure varies with the load. The second extraction point is equipped with B.T.H. standard automatic extraction valve gear, and the normal pressure is 15 lb. per square inch, the normal maximum quantity of steam required from this point being 14,500 lb. per hour. To provide process steam at 15 lb. per square inch pressure when the turbine is not running and to give make-up steam if more steam is required than the turbine can supply under any conditions of loading, an automatic relay-operated steam pressure reducing valve has been installed.

The surface condenser is capable of maintaining a vacuum of 28·75in. when the turbine is carrying a load of 1050 kW, and 2500 lb. and 14,500 lb. of steam per hour are being extracted at the first and second tapping points respectively, and when supplied with 65 deg. Fah. cooling water at the rate of 1000 gallons per minute. The centrifugal circulating water pump is in a pump house some 70 yards away from the condenser. It is driven by a 13 h.p. B.T.H. compound-wound, shunt characteristic type motor, at a normal speed of 1440 r.p.m., and is controlled by B.T.H. floor-mounted control gear, capable of giving a speed variation of ±5 per cent. The B.T.H. Company has also supplied motors and control gear for the paper-making machines installed in the mill.



1250 KW TURBO-GENERATOR FOR PAPER MILL

The Automatic Fireman.

AMONG the anxieties which harass the power station engineer in his determination to "keep the juice on," there is that of fire in unwanted places, and modern conditions of high-temperature working have greatly accentuated it. There may be fires of dust drawn into the plant by the cooling and ventilating air; there may be burning of insulating material, possibly caused by a short circuit, and there are oil fires. The latter are not necessarily confined to the boiler-house, where coal is probably the fuel, but may develop in the turbine room—an outstanding example is that of Brussels—where large quantities of oil are in circulation for lubricating and other purposes. The ignition of these oils may be effected by means which were not appreciated only a few years ago, but Mather and Platt, Ltd., of Manchester, have provided an antidote in the "Mulsifyre" system of fire extinguishing, of which we gave a preliminary note in THE ENGINEER of October 14th, 1932.

In a modern power plant of, say, 250,000 kW there may be as much as 200,000 gallons of oil in constant use, although it does not burn oil for raising steam, and this oil is inevitably in more or less intimate association with the hot parts of the generating machinery.

Steam temperatures of from 600 deg. to 700 deg. Fah. are now fairly common, and although the oils used for lubrication, governor control, and in transformers may be guaranteed to have flash points above those temperatures, it has been proved that fires may be originated by their coming into contact with pipes carrying steam at such temperatures. It appears that the oil may be "cracked," freeing the low flash point fractions, and that these volatilised fractions will react with the oxygen of the atmosphere exothermically in the production of aldehydes, acetic acid, &c. The result is that substances are produced which have flash points as low as 175 deg. Fah. There is also the consideration that any oil, if it is divided up into a very fine spray, such as might be produced by a leaky joint in a lubricating pipe, is readily ignitable. The lagging of hot steam pipes is not a complete safeguard, as some oil may find its way through crevices in the lagging, the cracking process proceed, and a greater supply of oil outside set fire to.

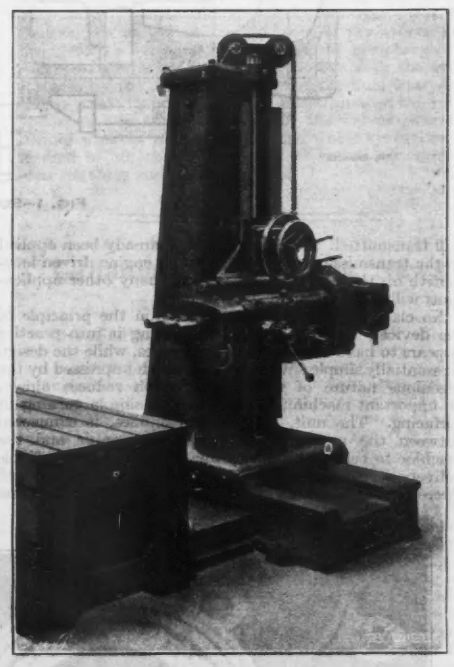
The "Mulsifyre" system of subduing oil fires depends, as the name indicates, on the incombustibility of an oil emulsion. An emulsion consists of minute globules of oil encased by a film of water. This water prevents access of air to the oil, so it cannot burn. Obviously a surface layer of emulsion is a protective against any oil below it catching fire.

The action of the "Mulsifyre" apparatus is to convert the surface of any (we are assured by the makers that *any* oil is amenable) into a fine emulsion, which is non-flammable. The effect is produced by the bombardment of the oil by a high-pressure water spray, produced by a device very similar to the Grinnell fire sprinkler. The blanket of emulsion may amount to only the equivalent of a film of water one-hundredth of an inch thick, but it will quench a fire within one or two seconds. It also has the advantage that within a few hours even that small amount of water will separate out and leave any remaining oil as useful as before.

A Horizontal Drilling Machine.

A HORIZONTAL drilling machine with some unusual features, which has recently been made for a British firm of engineers by Kitchen and Wade, Ltd., of Halifax, Yorks., is represented in the accompanying engraving.

As will be seen, the drilling head has three spindles, which are intergeared, but can be spaced apart, according to the pitch of the holes it is desired to drill, within the limits of 4in. and 6in. The outside spindles can also be readily removed to allow the machine to be used as a single horizontal drilling machine. The saddle has well extended ways on the column and is counterbalanced, while the column is carried on the bed by ball bearing rollers. The main spindle, which has a minimum diameter of 2in., is splined for driving by an electric motor mounted on the back of the saddle. Three spindle speeds and three rates of power feed are provided in the saddle besides quick and fine adjustments of the spindle. The work table measures 4ft. by 2ft. 6in. by 2ft. 2in., and the length of travel of the column is 4ft.



TRIPLE SPINDLE HORIZONTAL DRILLING MACHINE

CATALOGUES.

J. H. SANKEY AND SON, Ltd., The Hill, Ilford.—A new "Pyruma" fire cement catalogue.

WHITLEY, MORAN AND CO., Ltd, 1, Tithebarn-street, Liverpool, 2.—"The Cement Gun in Action."

HAYWARD-TYLER AND CO., Ltd., Luton, Beds.—Catalogue S.M. of submersible motors and pumps.

RUSTON AND HORNSBY, Ltd., Lincoln.—A catalogue describing a new range of oil engines, type V.Q.B.

OZALID COMPANY, Ltd.—A brochure describing the Ozalid process of dry developing photo printing papers.

BULLERS LTD., 6, Laurence Pountney-hill, E.C.4.—A new catalogue of pin type insulators and components.

THE STANTON IRONWORKS COMPANY, Ltd., near Nottingham. "The Stanton Iron Road and the Mersey Tunnel."

A. C. WICKMAN, Ltd., Coventry.—A leaflet on the "Ryder" centrifugal babbitting machine for connecting-rods.

A Hydraulic Transmission Unit.

A FEW days ago we had the opportunity to inspect in the maker's works the very interesting fluid power transmission unit, illustrated by a number of engravings on these pages. According to independent tests, the results of which are given at the end of this article, it has not only a high maximum efficiency—84 per cent.—but also maintains a high efficiency over a wide range of speeds. The unit is made by Haslam and Newton, Ltd., of Derby, in a range of seven sizes for powers from 10 to 156 h.p., and for speeds of the driving shaft of 1500 to 600 r.p.m. By the operation of a small external hand wheel mounted in a convenient position, the speed of rotation of the output shaft can be varied in an infinite number of steps from zero up to that of the input shaft. At zero speed the torque is still transmitted. A similar unit has already been applied to the transmission of power in an oil engine driven locomotive on the L.M.S. Railway, and many other applications will occur to our readers at once.

No claim is made for any novelty in the principle of the device. But the method of putting it into practice appears to have considerable advantages, while the design is essentially simple. We have been much impressed by the ingenious nature of the design, which reduces almost all important machining operations to simple turning or surfacing. The unit, as its name implies, is connected between the prime mover or electric motor and the machine to be driven. The prime mover drives a variable delivery constant speed positive acting pump, which forces oil into a similar device contained within the same casing, and causes it to act as a motor, and thus drive the output shaft. By altering the rate at which the pump delivers oil, the speed of rotation of the motor side is varied from zero up to the maximum, while the torque is tranmitted even at zero speed. Moreover, by the use of a simple auxiliary mechanism, which alters the valve motion of the motor, the direction of rotation of the output shaft can be reversed without any loss of efficiency.

The actual details of the design are best followed by frequent references to the line engraving, Fig. 1, in conjunction with occasional observation of the tone engravings. The whole device is contained within a cylindrical casing, and the larger parts are all held in place by the tightening up of the ring of bolts joining the two parts of the casing. The driving shaft—on the left in Fig. 1—runs in two heavy roller bearings, and is maintained in correct axial position by a double-purpose ball-bearing at the outer end. It carries an excentric, the throw of which is capable of being varied by a mechanism to be described later. Encircling the excentric there is a large double row roller bearing, the outer race of which is again encircled by a split ring—see Fig. 2. The two parts of this ring fitting on each side hold in position seven carrier lugs, which, as will be better observed from Fig. 3, hold pins on which are mounted steel rollers, one on each side of each lug. These rollers fit into slots in a cylindrical casting fitting within the bore of the outer casing. The action of the pump will now begin to become clear. As the driving shaft turns, the whole assembly of parts mounted on the excentric is carried round a circular path, so that the rollers reciprocate up and down the slots. The pumping action is not, however, confined to the slots. The intervening spaces between the central ring and the cylindrical casting contract and expand as the assembly travels round, and are also made to contribute to the pumping action. Owing to the pumping pressure, the rollers are forced against the sides of the slots and down on to the ring, and thus automatically seal the delivery from the suction side; and, although a close fit in the slot is desirable for mechanical reasons, the efficient operation of the pump is entirely independent of it. As the rollers are free to revolve whilst still maintaining the seal, there is no sliding friction on their peripheries, and the rate of wear is justifiably claimed to be very slow.

For the inflow and discharge of oil, there is a port communicating with each slot and another with each space, the valve mechanism being so arranged that the passages communicating with a slot and an adjacent space are covered or uncovered simultaneously. The passages are covered and uncovered by the "wheel" valve to be seen clearly in Fig. 4. Oil is drawn in from the space within the rim of the wheel and discharged outside its periphery, and the wheel is operated by a fixed excentric on the end of the main shaft, arranged to lead the main pump excentric by 90 deg. As arranged for the purpose of photography, ports open for discharge are to be seen on the side nearest the camera, and for suction on the far side within the wheel. As will be seen from Fig. 1, the wheel valve fits between two flat surfaces with small clearances on each side. The oil coming out of the pump is discharged into an annular chamber surrounding the central suction space. The casting forming this central block is illustrated in Fig. 5. If the engraving, Fig. 4, is carefully examined, there will be seen beneath the valve an object reminiscent of a fly-wheel. It is, in fact, a brass casting hollow on one side and solid on the other, mounted on the main shaft with the object of partially counteracting the out-of-balance force due to the excentric. Owing to the fact that the throw of the excentric is variable complete balance is only possible at one position—usually half throw.

Except for the fact that the excentric throw is fixed the "motor" end of the transmission unit is an exact replica of the pump. The pressure oil enters the valve ports from the outside of the wheel, and is exhausted into the centre. The speed of rotation of the motor is governed entirely by the amount of oil delivered by the pump and the motor spindle is, of course, independent of that of the pump.

Before passing on with this description to some notice of the various mechanisms included within the casing for control purposes, it may be worth while to direct attention to the simplicity of the general design of this transmission unit. Nearly all the main parts are either rings, discs, or cylinders, which may easily be machined to close limits of accuracy, although, in fact, the design is such that ordinary workshop tolerances give as much accuracy as is required. Clearances throughout are simply set by the thicknesses to which various parts are machined. That, for instance, on the sides of the wheel valve which has pressure outside and suction within is determined by a spacer ring machined perhaps two-thousands of an inch thicker than the wheel. Metal-to-metal face joints are made throughout for all the cylindrical pieces fitting into the main casing, and they are maintained tight by the pull exerted by the ring of external bolts. Lest by any chance oil might find its way beneath the joint between the two parts of the outer casing, there is inserted there a lead ring. It is also possible that oil might leak out along the shafts, and special glands are provided to meet this contingency. Each gland is enclosed between housings on the shaft and the casing, and consists of two machined discs separated by a U section spring-like ring of special metal, which is slightly compressed. From our own observation, we are able to state that these glands seemed very efficient in preventing the leakage of oil.

There remain to be described a number of auxiliary devices included within the casing. It has already been mentioned that the throw of the excentric on the pump shaft is variable. At the point where the excentric is mounted upon it the shaft has large flats on each side, against which there are butted up brass pieces shaped in section like half moons and encircled by a steel ring. Each of the brass pieces—see Fig. 6—carries on its inner side

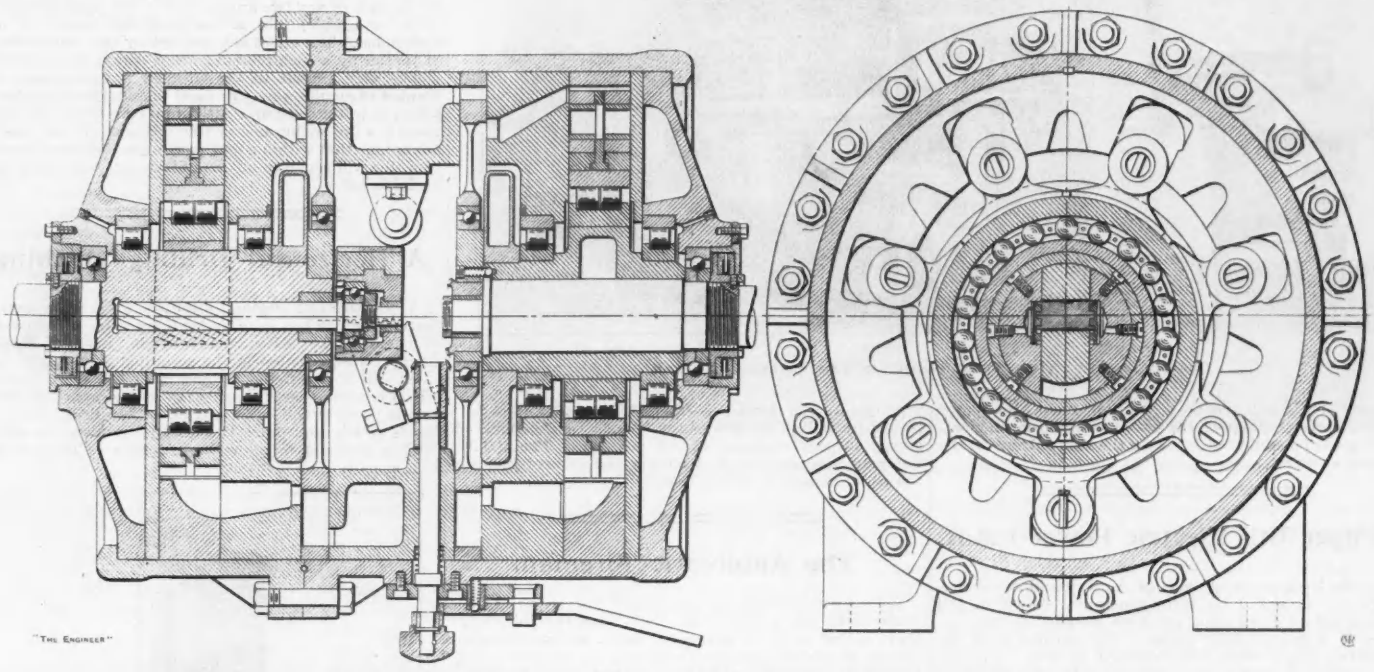
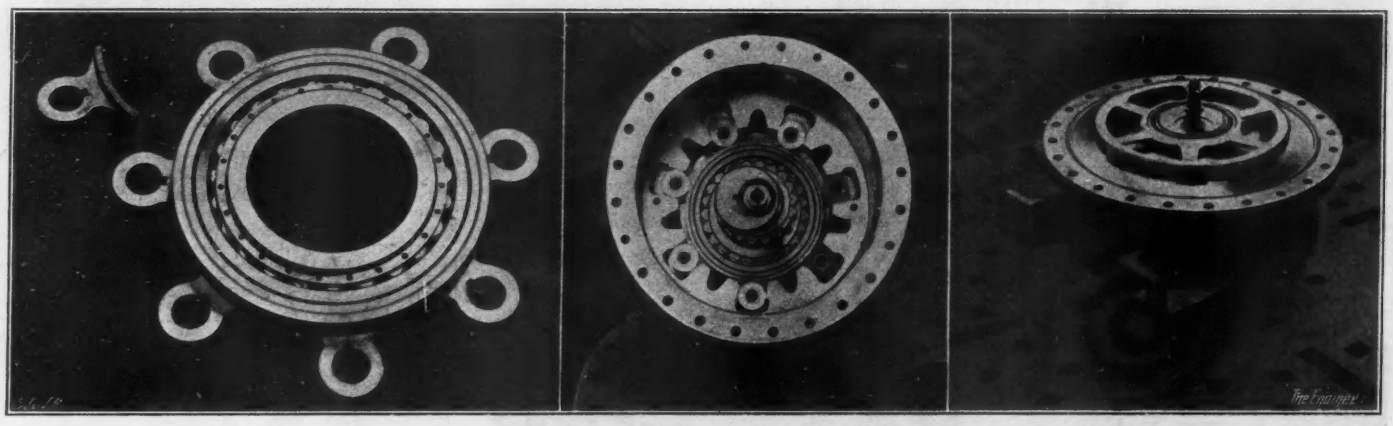


FIG. 1—SECTIONAL VIEWS OF COMPLETE HYDRAULIC TRANSMISSION UNIT



FIGS. 2, 3 AND 4—SUB-ASSEMBLIES OF PARTS OF HYDRAULIC TRANSMISSION UNIT

a steel piece cut with diagonal slots, which engage with mating slots on the excentric operating rod. The latter is capable of moving axially along the shaft under the influence of a rack and pinion mechanism operated by an external hand wheel—see Fig. 1. When it is so moved, the brass pieces, together with the ring that encircles them, are caused to move transversely, and in this way the excentricity of the ring is varied.

While no variable excentricity has to be provided for the "motor" side, a mechanism is desirable in some applications for reversing its motion. In order to cause the motor to reverse its direction of motion, it is necessary to swing the valve excentric through 180 deg. from 90 deg. in advance for one rotation to 90 deg. in advance for the other. In accordance with this requirement, the excentric is mounted on a bush on the shaft, and carries a small bevel gear—see Fig. 1. A shaft projecting radially inwards from the outside of the casing carries at its end

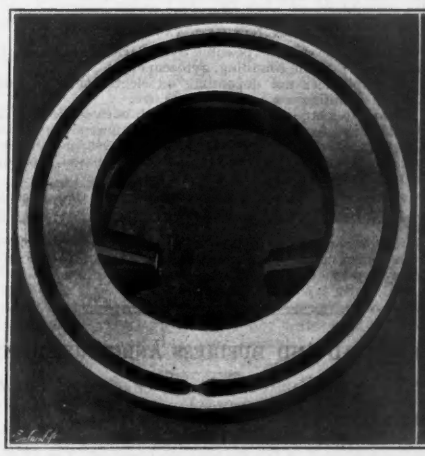


FIG. 5—CENTRAL ANNULAR CASTING

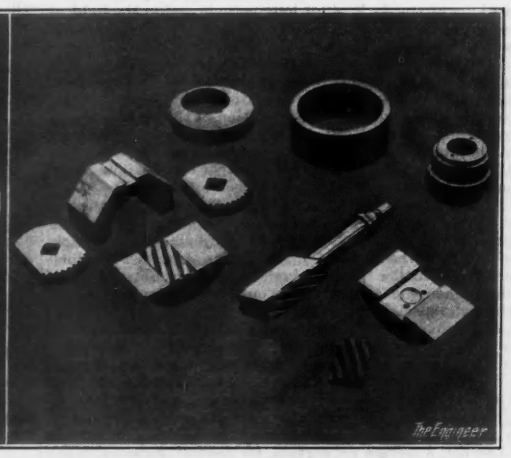


FIG. 6—PARTS OF VARIABLE EXCENTRIC MOTION

the mate of this bevel gear. This shaft is axially slidable and is normally held outwards by a compression spring, so that the bevel gears are out of engagement. Outside the casing it carries a small pinion meshing with the teeth on the end of a small hand lever. In order to reverse, the main control hand wheel of the unit is first operated to bring the driven shaft to rest. A knob on the end of the radial shaft is next pressed, thus bringing the bevel gears into mesh, and the hand lever is either pulled up or pressed down, causing the radial shaft to revolve and the valve excentric to be moved through 180 deg. relatively to the driven shaft. The knob is then released and the main control hand wheel operated to set the output shaft in motion. The excentric is held in its two extreme positions by the ball and socket lock to be seen in the drawing. Lest damage should be caused to the unit by improper use of the mechanism, an interlock is provided between the main control hand wheel and the

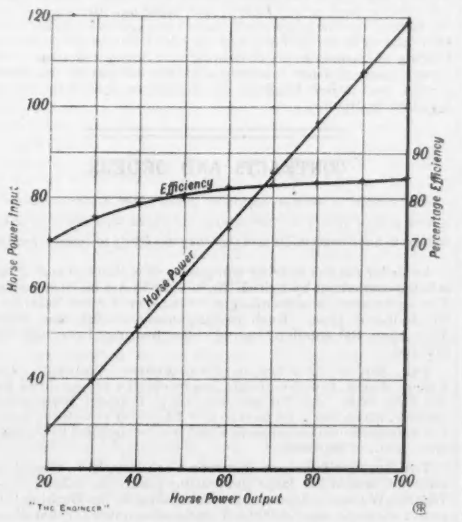


FIG. 7—PERFORMANCE CURVES

reverse knob, so that the bevels cannot be engaged if the driven shaft is in motion.

Besides the two control mechanisms just described, there are mounted in the central casting two safety valves. One, which is spring loaded, relieves the pressure on the delivery side of the pump should it, for any reason, become excessive, by allowing oil to flow back directly into the centre without passing through the motor, while the other, of mushroom pattern, opening towards the pressure side, is provided against the possibility of the motor over-running the pump, draining the pressure side of oil and forcing it all into the suction side.

In operation the unit is very silent and, in spite of the fact that the rotors are necessarily slightly out of balance, remarkably free from vibration when running. Oil is continually circulated out of the unit through a small cooler and back again. But with that exception, there are no auxiliaries. There is, of course, no necessity for the pump and motor to be mounted in the same casing, although it makes the neatest arrangement. For certain applications it might be an advantage to separate them and connect up by pipes. Nor is there any reason why the pump and the motor should not be of different sizes. A small high-speed pump might, for instance, be arranged to drive a large, low-maximum-speed motor if a large reduction in speed with a corresponding increase of torque was desired. It will, therefore, be seen that the unit is adaptable for a variety of purposes. The arrangement of a pump alone without the motor is illustrated in the line engraving, Fig. 8. The excentric control rod projecting out of one end of the casing can be arranged for either manual or automatic control according to the purpose for which the pump is being used. A constant pressure with variable delivery could, for instance, be obtained by the use of a suitable relay. As shown, the central rod is arranged for some form of hydraulic operation.

On January 15th and 16th last a test of a 100 h.p. unit was carried out for the firm by Professor A. H. Gibson, of the University of Manchester, and we print below some extracts from his report:

The unit tested, which is designated as type C, was designed to transmit 100 h.p. with a speed of 750 r.p.m. at the driven shaft, and with a working pressure of 800 lb. per square inch.

Test Methods.—As installed for the tests the driving shaft was directly coupled to an electric motor whose input was measured in the usual way by standardised ammeter and voltmeter. The driven element was directly coupled to a Heenan and Froude dynamometer, whose readings enabled the output power to be determined.

Tests were carried out with a constant speed of the electric motor and with a wide range of speeds of the driven shaft, the electrical input and the horse-power output being carefully determined at each speed and load. Under the conditions of the test the accuracy of the final results is of the order of ± 1 per cent.

This particular gear unit was designed for a working fluid pressure of 800 lb. per square inch, and the majority of the tests were carried out with the load on the dynamometer adjusted so as to give this pressure. As a matter of interest, two or three tests were also carried out at 600 lb. per square inch, and one at 1000 lb. per square inch.

Test Results.—The results of the tests are shown in the following table, and the results of those at 800 lb. per square inch are shown graphically in Fig. 7:—

Speed of Driving Motor 750 r.p.m.

Working pressure, lb./sq. in.	Speed of driven shaft, r.p.m.	H.P. input to gear.	H.P. output of gear.	H.P. output / H.P. input.
800	137	26·4	18·3	0·693
,,	150	28·2	20·0	0·709
,,	225	39·5	30·0	0·760
,,	300	51·2	40·0	0·781
,,	375	62·5	50·0	0·800
,,	450	73·1	60·0	0·820
,,	525	85·1	70·0	0·823
,,	600	96·2	80·0	0·830
,,	675	107·8	90·0	0·835
,,	750	119·0	100·0	0·840
1000	155	36·0	25·9	0·719
600	250	30·5	22·5	0·735
,,	500	56·0	45·0	0·804
,,	750	84·4	68·2	0·808

The results of the latter tests show that the overall efficiency of the gear is high. It attains a maximum value of 84 per cent. when the speed ratio approximates unity; exceeds 80 per cent. for all speed variations not greater than 2 : 1, and does not fall below 70 per cent. even with so great a speed variation as 5 : 1. It is to be noted that in the particular gear on test the normal capacities of the pump and motor per revolution are identical, so that with the control wide open the speeds of the two shafts are, except for the slight effect of slip, also identical. If, however, the design were such as to make the capacity of the motor per revolution, say, four times that of the pump, the maximum speed of the driven shaft would be one-fourth that of the driver, and with this speed reduction the efficiency would be of the order of 84 per cent. The speed reduction in this case would need to be 8 : 1 before the efficiency was reduced to 80 per cent.

I have no knowledge of any other hydraulic variable-speed transmission gear which gives such high efficiencies. It is, indeed, of the same order as is possible from a reciprocating pump working under ideal conditions, and is much higher than is possible from any type of centrifugal pump.

Smoothness of Operation of Gear.—Throughout the tests the operation of the gear was smooth. There was no sign of cavitation, and, indeed, the fluid velocities are, in general, so small that no such effect is to be anticipated.

Examination of Gear After Test.—After the tests were completed, the gear was entirely dismantled and stripped for inspection. The unit had previously been put through a non-stop run of 144 hours' duration, and had, I understand, run altogether for at least 250 hours. The condition of all the working parts was excellent. There was no sign of wear. The only sign of operation consisted of a slight polishing of some of the working surfaces which was, however, not sufficient in general to remove the original grinding marks. The general condition of the surfaces was such as to confirm the contention that rolling and not sliding contact occurs between the sealing vanes or rollers and the drum and plane surfaces against which they bear, and which provides the seal between the high and low-pressure sides of the system. There was no sign of wear on the aluminium

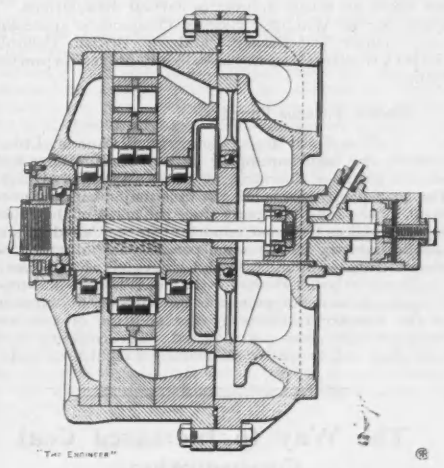


FIG. 8—PUMP UNIT

alloy distribution valve rings, or on the various roller bearings. The general impression left as the result of the examination was that such a gear would run almost indefinitely without appreciable wear. In any case, the only wear which could affect the efficiency would be that on the valves and on the sides of the rollers, since, owing to the very ingenious design the periphery of the rollers is always maintained in contact with the sealing surfaces by the working pressure of the fluid irrespective of any wear. Since there is no side thrust on the rollers, and since the relative motion of the valves over their sealing surfaces is small, while the whole system is submerged in oil, there is, indeed, no reason to anticipate wear on these surfaces.

Canadian Engineering News.

(By our Canadian Correspondent.)

New Pier at Halifax.

ON December 10th Canada's newest ocean pier commenced to serve the Dominion's commerce with the world, and the Port of Halifax had formally added to its facilities one of the finest structures of the kind in the world. The new unit has been named Pier "B." It is 1250ft. long, and extends into the harbour at right angles to the shore. It affords berthing accommodation for four ships, the water varying in depth from a minimum of 35ft. at low water at the two inner berths to 70ft. or more at the outer end of the pier. The pier is 300ft. wide. The two main one-storey transit sheds, which run parallel with the docks, are each 1100ft. long and 94·5ft. wide. The uncovered dockside working area consists of a strip 19ft. wide running the entire length of each of the main transit sheds. Single-line railway tracks are provided on both strips, and permit the transfer of freight directly from ship to railway cars and from cars to vessels. At the deep-water end of the pier is another one-storey transit shed, with a floor area of 73ft. by 80ft., connecting the two main sheds. The open dock-side working area of this shed is 25ft. wide. The transit sheds are of steel framework construction with galvanised iron sheathing for the walls, in which a total of 168 lift doors are provided, allowing free passage of freight to and from the sheds the entire length of all the walls. The roof is of wood planking, covered with five-ply roofing paper, tarred and gravelled. Close under the roof is installed an automatic sprinkler system, through the 35,000ft. of piping of which a centrifugal pump forces sea water to 3349 nozzles. With a headroom of 15ft., the transit sheds, containing a floor area of 229,120 square feet, provide a storage capacity of 2,000,000 cubic feet. An open area, 73ft. wide by 1000ft. long, has been laid out between the two main transit sheds for railway and trucking services. In this area two lines of railway tracks with crossovers run alongside each of the sheds, while a concrete roadway has been laid along half the length of the area from the land end of the pier, entering each shed halfway down by means of a ramp. Offices and store rooms are contained in two two-storey buildings at the land end of the pier, the upper floors being fitted for use as offices, while the lower floors are designed for heated storage of perishable freight.

Rock Slide at Niagara.

The gradual recession of Niagara Falls recently resulted in the fall of a 200-ton pile of rock in the Niagara Gorge. This is the third slide at the cataract in three years. The rock tumbled from beneath "Table Rock" on the Canadian shore, at the extreme tip of the Horseshoe Falls. The two previous rock slides occurred in 1931 and 1934. A large bend developed in the American Falls in 1931. The slide in that year was estimated to weigh

80,000 tons. It was approximately 150ft. deep and 300ft. wide. The fall in August, 1934, was the second largest. It was estimated at 40,000 tons. The rock, sliding from the brink of the Horseshoe Falls, was about 200ft. wide and 50ft. deep. The latest fall wiped away a projecting ledge slightly below the top of the Table Rock. It did not break the surface crust, but left a cave in the gorge bank not visible from any point on the Canadian shore.

Electric Soil Heating.

During the last two years Canadian power companies have made considerable progress in the introduction of electric soil heating. In 1932 numerous installations were provided in the market gardening districts around Montreal, chiefly by the Shawinigan Power Company. In Ontario the Hydro-electric Power Commission has taken an active interest in several installations. In Manitoba the Winnipeg Electric Company is sponsoring experimental installations, and in British Columbia the B.C. Electric Company has already proved its practical value.

Electric Furnace Foundry.

The Ford Motor Company of Canada, Ltd., is constructing and equipping a new half-million-dollar electric furnace foundry at East Windsor, Ontario. The new plant represents the first major capital investment by the Ford Company since the onset of the depression, as well as the most important in the Canadian automobile industry in the same period. Initially, the new electric furnace foundry will be devoted to the casting of alloy steel crank shafts for the Ford V–8 car and truck. Present plans make provision for subsequent expansion of the foundry facilities by the addition of two more furnaces when they are required. The capacity of the new plant will be 200 crank shafts per eight-hour shift.

The Way to Increased Coal Consumption.

ADDRESSING the College of Technology at Manchester recently Mr. H. L. Pirie, Chief Engineer of the Coal Utilisation Council, dealt summarily with the suggestion that waste of fuel was good for the coal trade and the efficient use of coal bad for it. "I believe," he said, "that we must encourage consumers to use less fuel per unit of plant if more coal in the aggregate is to be consumed. To allow customers to waste fuel is simply to play into the hands of competitors."

RELATIVE VALUES OF DIFFERENT COAL.

Speaking of the merits of alternative fuels, Mr. Pirie said it was important to assess the relative values of different coals, because tonnage price was not necessarily an accurate index of commercial utility. The following table, he said, showed the method of ascertaining the true value of three coals offered by different salesmen to a consumer at the prices stated in Column 2.

The coefficient for the "sample" fuels is obtained by expressing their fuel costs per unit (Column 5) as a decimal of the "standard" cost. Column 7=Column 2×Column 6.

It was obvious, added Mr. Pirie, that it would not pay to use fuels "B" and "C" unless the prices were reduced by at least 2s. and 1s. 8d. per ton respectively.

A study of the foregoing by a coal salesman who had failed to book an order even though his price was lower than that of a competitor might help him to realise and understand why he had been unsuccessful in securing the business.

Mr. Pirie mentioned the "up-grading" of low-grade fuels through the efficiency of the appliances in which they were used. Designers of boilers, furnaces, and grates were continually improving their appliances with the object of increasing the range of coals which could be burned in them. He gave two examples of the economy thus effected. In one case, by the installation of mechanical stokers and the use of a lower grade of coal, the fuel bill for two Lancashire hand-fired boilers had been cut by £800 per annum and the cost of the new appliances was recovered in less than twelve months. In the other the weekly consumption was increased from 900 tons of "high-grade" coal to 1125 tons of "low-grade" by the installation of stokers, but the weekly fuel bill was reduced by £150.

1	2	3	4	5	6	7
Description of coal offered.	Quoted price per ton delivered.	Equivalent evaporation lb. water per lb. coal from and at 212 deg. Fah.	Thousands of lb. of steam generated per ton of fuel burned.	Fuel cost in pence per 1000 lb. steam.	Cost coefficient.	True value per ton.
	s. d.	lb.				s. d.
"A" washed singles	22 9 (273d.)	8·62	19·31	14·14	1·00	22 9
"B" slack	22 4 (268d.)	7·7	17·25	15·53	0·91	20 4
"C" beans	18 9 (225d.)	6·5	14·52	15·51	0·91	17 1

COLUMN 3 is ascertained from actual evaporation tests.
COLUMN 4=Column 3×2240÷1000.
COLUMN 5=Column 2÷Column 4.
COLUMN 6.—The coal showing the lowest cost per unit of steam generated (1000 lb.) is regarded as the standard of comparison and is given a cost coefficient of unity.

Here again the capital cost of the change over was recovered in less than a year.

Blending was another method of up-grading, for although the art of blending—and by blending Mr. Pirie did not refer simply to rough-and-ready methods of mixing—was by no means confined to low-grade fuels; the process did enable certain coals which would not otherwise have been suitable for steam raising or coking to be used for these purposes.

The blending of coals should, as a rule, be carried out by the distributor or merchant, who was generally in a far better position than the colliery to arrange for centralised delivery of many classes of coal drawn, in all probability, from different coalfields.

Test of Coal Distillation Plant.

A REPORT issued by the Department of Scientific and Industrial Research gives the results of a test carried out by the Director of Fuel Research on the low-temperature carbonisation plant of British Coal Distillation, Ltd., at Newbold, Leicestershire.

The Department has been empowered by the Government to test plants of this nature at the public expense, subject to special conditions which are set out in an appendix to the report. The object of the tests is to place in the hands of those interested accurate technical data on the quality and quantity of the yields, the throughput of the plant, the working temperatures, and the general ease of working, together with such other information as it may be possible to obtain under the limited conditions of the test. No attempt is made to pronounce on the commercial possibilities of the plants, for these can only be judged after working at steady load for long periods and in the light of complete knowledge of local conditions of prices, markets, and labour costs.

The present report describes the second test on this plant. A previous test had been carried out in November, 1930, but was not completely satisfactory, chiefly owing to lack of continuity in the operation of the retort, caused by mechanical difficulties in the coal charging plant and in the plant dealing with the separation of the coke. In 1933 the company applied for a further test, claiming that considerable improvements had been effected.

The process is an interesting one. The retort is described in the account of the second test as consisting of a rotating tube, 90ft. long and 9ft. in diameter, inclined at an angle of 1 in 20 to the horizontal. It forms a shell, inside which are seven smaller tubes through which the coal passes from the higher end to the lower, emerging when carbonised through special valves in the outer shell. Circulating gases provide the heat for carbonisation. Producer gas is burnt in a special combustion chamber, and the resulting hot burnt gas is passed up through the retort, driving off and mixing with the gases and vapours from the coal. On leaving the retort these gases are stripped of tar, liquor, and dust and, having a low but appreciable calorific value, re-enter the circulation at the special combustion chamber, a certain proportion, for control purposes, being allowed to escape to atmosphere.

The coal carbonised is cheap slack, and the solid products are separated in water into clean coke and "dirt." The former is subsequently compressed into briquettes and the latter is used for steam generating in the plant.

Full details are given of the materials consumed in the plant, and of the products obtained. The results attained in 1930 and in 1933 are given in the following table:—

	Test November, 1930.	Test March, 1933.
Duration of test, hours	125·75 ..	119·25
Coal.		
Size as charged, per cent. through ¼in. mesh	25 ..	87·4
Total coal charged, tons	340·6 ..	481·3
Average throughput per 24 hours, tons	65·0 ..	96·9
Moisture in coal as charged, per cent...	19·2 ..	17·4
Dry coal charged, tons	275·2 ..	397·6
Coal to producer per 100 tons throughput, tons	11·9 ..	6·2
Coke.		
Clean coke (dry) produced, tons.. ..	102·0 ..	180·8
Volatile matter, per cent.	18·6 ..	19·9
Ash content, per cent.	10·0 ..	10·9
Yield of dry coke per ton of coal as charged, cwt.	6·0 ..	7·5
"Dirt."		
"Dirt" (dry) produced, tons	72·6 ..	109·5
Volatile matter, per cent.	22·4 ..	20·6
Ash content, per cent.	16·8 ..	38·3
Yield (dry) per ton of coal as charged, cwt.	4·2 ..	4·6
Tar.		
Dry tar produced per ton of coal as charged, gallons	12·4 ..	8·2
Specific gravity at 15 deg. Cent.	1·120..	1·140
Power.		
Power used per ton of coal as charged, units	35·6 ..	17·1

The retort is claimed to be capable of carbonising 100 tons of slack coal per day, and during the test—which occupied five days—the throughput was 97 tons per day, no difficulty being experienced with the retort mechanism.

The apparatus for the separation of clean coke from "dirt" was, however, inadequate at the full retort capacity, but a general description is given of the additional plant that would be necessary to remove this inadequacy and complete the process from the carbonising stage to the production of smokeless domestic fuel.

Weight, hydrogen, and carbon balances show that the yields given can be taken as correct, a somewhat large loss of carbon being partly explained by loss of fine coke dust, which could be remedied. The heat supplied for carbonisation was 17·5 therms per ton of coal as charged, and this can be considered as a very satisfactory figure. An addendum to the report gives technical data on the domestic fuel produced, including combustibility tests.

THOMAS GRAY MEMORIAL TRUST.

UNDER the will of the late Thomas L. Gray, the Royal Society of Arts, London, W.C.2, has been appointed residuary legatee of his estate for the purpose of founding a memorial to his father, the late Thomas Gray, C.B., who was for many years Assistant Secretary to the Board of Trade (Marine Department). The objects of the Trust are "The Advancement of the Science of Navigation and the Scientific and Educational Interests of the British Mercantile Marine."

The Council now offers the following prizes:—

I. *Prize for an Invention.*—A prize of £100 to any person who may bring to their notice an invention, publication, diagram, &c., which, in the opinion of the judges appointed by the Council, is considered to be an advancement in the science or practice of navigation, proposed or invented by himself in the period January 1st, 1930, to December 31st, 1935. Entries which have already been considered by the judges in the years 1930–34 are not eligible for further consideration unless they have since been materially modified.

II. *Prize for an Essay.*—A prize of £100 for an essay on the following subject:—

MODERN NAVIGATIONAL APPLIANCES.

(1) Appliances made possible by electricity on board, *e.g.*, wireless D.F., echo sounding, gyroscope, &c.

(2) Appliances not depending on electricity, *e.g.*, range-finding, sounding machine, compass, &c.

Candidates are expected to deal with both sections. They should write from a practical point of view, and give their views on the advantages and disadvantages or failures (if any) of modern electrical aids to navigation, based, if possible, on personal experience.

Competitors must send in their essays not later than December 31st, 1935, to the Secretary, Royal Society of Arts, at the above address.

Both competitions are open to persons of any nationality, but, in the case of the essay competition only, competitors must be past or present members of the seafaring profession.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

THE LEEDS AND BRADFORD BOILER COMPANY, Ltd., informs us that its London office is now at Coventry House, South-place, E.C.2 (telephone, Metropolitan 3433).

MR. ERIC A. ROBINSON, A.M.I. Mech. E., has been appointed managing director of the Superheater Company, Ltd., London and Manchester. He joined the company in 1921 and was appointed general manager in July, 1933, and a director in September, 1934.

LAND adjoining its Brentford works has been acquired by Tecalemit, Ltd. The site acquired covers 5000 square feet, making the total area of the site now owned by the company approximately 110,000 square feet. It is intended to build an extension of the works which will cover this new land.

A MERGER has taken place between the Electrode Company of Sheffield, Ltd., producers of amorphous carbon electrodes, and the Acheson Graphite Corporation, suppliers of graphite electrodes to the English markets, resulting in the formation of British Acheson Electrodes, Ltd., which company will manufacture and sell both carbon and graphite electrodes, as well as graphite powders. British Acheson Electrodes, Ltd., have opened administrative and sales offices at Town Hall Chambers, 87, Fargate, Sheffield, 1.

CONSEQUENT upon the retirement of William Asquith, Ltd., Halifax from participation in the sales organisation of Associated British Machine Tool Makers Ltd., and the resultant amendment of the firm's lines of manufacture, an agreement has been reached between Craven Brothers, Ltd., Reddish, near Stockport, and William Asquith, Ltd., under which Messrs. Asquith relinquish the making of railway wheel turning lathes, tire turning and boring lathes, axle centring, turning and ending lathes, also the large centre lathes of various kinds for which they had been tendering; and Messrs. Cravens will cease the making of various kinds of drilling and boring machines. The arrangement will not interfere with the companies' respective service and other facilities in regard to machines already supplied by them.

CONTRACTS AND ORDERS.

The Editor is always happy to print short announcements of contracts and orders in this column provided they are sent to him in time to have news value and that they are likely to interest readers.

AN order for the bearing equipment of a Russian rolling mill is being carried out by British Timken, Ltd., Aston, Birmingham. The equipment consists of eight large tapered roller bearings of the four-row type. Each bearing measures 2ft. 7in. across. More than 400 smaller tapered roller bearings have also been ordered.

THE BRUSH ELECTRICAL ENGINEERING COMPANY, Ltd., Falcon Works, Loughborough, has received a repeat order from the Blue Star Line for six 300 b.h.p. opposed four-cylinder engines, which are to be used in new Blue Star vessels for driving CO_2 refrigeration compressors which will be supplied by J. and E. Hall, Ltd., of Dartford.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., Rugby, has received orders for large generating plant, as follows:—One 75,000-kW turbo-alternator for installation in the Barking "B" power station; one 50,000-kW turbo-alternator for installation in the Kearsley power station; the alternator for this machine will be wound for 33,000 volts; one 30,000-kW turbo-alternator for the Derby and Notts. Electric Power Company's Spondon power station.

THE ENGLISH ELECTRIC COMPANY has been awarded a contract by the Portsmouth Corporation for twelve double-deck top-covered all-metal omnibus bodies. The bodies will be designed so as to be suitable for mounting on a two-axle forward-control chassis and will be provided with vestibule rear entrances. The total seating capacity will be for fifty passengers, twenty-four being accommodated in the lower saloon and twenty-six in the upper saloon.

INTERNATIONAL ROAD CONGRESS.—A presentation was made to Mr. E. B. Hart on February 7th at the Ministry of Transport on behalf of nearly 150 subscribers who have taken part in International Road Congresses during the past twenty years, and who wished to express their indebtedness to him for the valuable part he has played in the organisation of the Congresses and ensuring the comfort and convenience of delegates from the year 1913 onwards. The gift took the form of furniture. Sir Frederick Berryman, Chairman of the Highways Committee of the County Councils Association, presiding at the informal ceremony, laid stress upon the unfailing patience, courtesy, and skill displayed by Mr. Hart in solving the thorny problems presented to him by perplexed travellers; reference was also made to his lengthy association with the Road Board and the Ministry of Transport.

Markets, Notes and News.

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer. A comprehensive list of the prices of materials mentioned below will be found on the next page.

The American Iron and Steel Trade.

Although it is said that business in the United States is being held up by the uncertainty regarding the gold-dollar clause, the American iron and steel industry seems to be making satisfactory progress. The rate of production has increased considerably during the past month, and for January the production of pig iron is estimated at 1,477,336 tons, compared with a December output of 1,028,000 tons. The production of steel has also expanded during January, and amounted to 2,834,170 tons, compared with 1,941,127 tons in December. The industry is estimated to be producing at the rate of 37,000,000 tons per annum, which represents 52·8 per cent. of the trade capacity, as compared with about 39·2 per cent. early in January. One of the busiest sections of the United States steel trade appears to be the tin-plate department. Last year the production of tin-plates reached 1,372,000 tons, the exports amounting to 166,700 tons. There has been an important revival in the demand for automobiles, and, according to some authorities, this industry should take 25 per cent. of this year's steel output. Until recently the American steel makers anticipated that they would benefit considerably from Russian orders, but their prospects in this direction have received a setback, owing to the failure of negotiations for increasing Russian credit. An order for cart wheels and axles for the Soviet, involving about 400,500 tons of steel, was recently taken by the Carnegie Steel Company. Recently a trade treaty was negotiated with Brazil by the United States Government, which may affect the position of the steel works producing manganese steel, as it provides for a reduction in the duty on imports of Brazilian manganese ore of from 50 per cent. to one-half of 1 per cent. on the manganese content. The United States Steel Corporation, the most important combination in the industry, reduced its net loss during 1934 to 21,700,900 dollars, compared with 36,501,000 dollars in the previous year. The total pay roll of the American steel industry during 1934 reached 457,842,517 dollars, the average number of employees being 409,349.

The Pig Iron Market.

The general situation in the pig iron market does not alter much. Most of the business that has passed since January has been limited to comparatively small parcels; but now and again important contracts have been entered into for delivery over the next few months by consumers who wished to secure their supplies at current rates. There are few buyers, however, who anticipate an advance in prices during this quarter, since the demand is not more than sufficient to balance production. Probably the North-East Coast is the only district which is working upon a really narrow margin of stocks. In other parts of the country substantial stocks exist in the makers' yards; but it is a good feature that these are not being increased to an extent that matters. The Cleveland producers have enlarged their export sales of late, and in January sent 15,300 tons overseas, compared with 13,300 tons in December. Most of this business had to be taken at cut prices owing to keen competition from foreign makers; but the sales enabled the Cleveland furnaces to check a tendency for their holdings to grow. Now that orders and shipments to Scotland have expanded they are able to take a more independent attitude towards export business. Specifications from local consumers, also, have helped to strengthen the tone of the market. Conditions in the Midlands are satisfactory as the demand has improved to an appreciable extent during the past fortnight. Many of the large users of Midland irons have covered their requirements for a long period ahead, and as a consequence the orders reaching the producers are on the light side. The position has improved, however, as there is a more regular flow of specifications. The recent increase in the demand from the light castings foundries has been maintained, and the heavy engineering foundries continue to take large tonnages. No alteration in prices in this district in the near future seems to be expected by consumers or contemplated by producers. Similar conditions rule in the Lancashire market. Business in pig iron has shown a noticeable tendency to increase, and as the spring demand for light castings develops it should have a favourable influence upon the foundries' pig iron requirements. Transactions in hematite have become more numerous and there has been no decline in the heavy deliveries to the steel works in the Midlands and South Wales. Some of the North-West Coast makers are reported to have sold their production until the end of June. It is expected that a new furnace will be lighted at Millom within the next few weeks. Lately the overseas demand for hematite has increased. Italy has been the best overseas market, but fair parcels have been sent to other parts of the Continent.

Scotland and the North.

The Scottish steel works are busily employed and are likely to remain so for some time to come; but the work upon which they are engaged is principally old contracts, and for the past fortnight, at any rate, there has been a lull in new business. There is no lack of confidence in the market, however, and anticipations are general that before February is over the demand will expand, although there seems little hope of any notable improvement in the export trade. A gradual broadening in the home trade is looked for by the manufacturers, but no expansion in overseas business seems probable until there is a relaxation of the exchange restrictions in force in many of the markets and some relief from the high tariff barriers. Heavy tonnages of shipbuilding steel have been delivered to the shipyards, but a moderate amount of new business continues to reach the steel works. The Scottish sheet works are not well off for orders, but deliveries against old contracts are being made on a good scale. The demand for structural steel is well maintained, and a fair tonnage of joists and sections is going to the constructional engineers, a number of whom have contracts on their books which will keep them employed for a considerable time. The general engineers and the marine engineering concerns have recently improved their position as regards orders, and are providing a steady outlet for steel. The re-rollers are working on a small reserve of orders, although lately they have found business more active. Some of the improvement may be attributed to the prevailing belief that an increase in the duties on finished steel is probable. Business in the Lancashire market is only moderately good, and it is expected that active conditions will develop when the plans for rebuilding bridges and roads in the county are further advanced. A number of contracts have been worked off recently by constructional engineers, and apparently new business is not coming forward to replace them, so that the demand from this industry is not particularly good. The most active side of the market is that concerned with the lighter classes of steel material, and this demand promises to increase as the season advances. Bright drawn steel bars are in good request, and the call for special steels has lost little ground in this district. Lately there has been more inquiry for boiler plates, and it is expected that some of the firms which placed orders before the recent advance will shortly enter the market.

The Midlands and South Wales.

Satisfactory conditions rule in the Midland steel trade, and the works in most cases are better off than they were at the end of the year, in spite of the lag in new business which occurred during the latter part of January. The volume of trading has increased considerably this month, and has been spread more evenly over the market. The requirements of the constructional engineers absorb a large tonnage of steel, and it is an interesting point that whilst they have been buying on conservative lines since the end of the year they now show a marked disposition to enter into forward contracts. Other branches of the engineering trade are also providing a good outlet for steel materials, and lately the collieries have placed a considerable tonnage of new business, whilst their specifications against contracts have accounted for a large tonnage. The prices for arches and rails are all under control, the quotations being, for bridge and flange rails, £7 10s. to £7 12s. 6d., and for light and heavy arches, £7 15s. and £8 15s. respectively. The demand for small bars and strip is one of the weak spots in the market, and although the trade with the Continent has been greatly reduced since it was announced that the British steel makers' application for higher duties was under consideration, only a moderate quantity of new business has reached the British makers. Complaints are heard from the re-rollers of the competition of works outside the Association; but the situation has not altered much for some months. Transactions in plates have been limited in number, and not particularly heavy as regards tonnage. The recent spurt in business in boiler plates, also, has not been maintained, and the makers are rather poorly off for work in this department. In South Wales the markets have been quieter during the past week than at any time since the end of the year. There is a steady demand for certain classes of joists and sections, and the mills have a fair amount of business in hand. The reduction in the output of tin-plates, however, has been reflected in slower operations at the works producing tin-plate bars. To a great extent the quieter conditions in the South Wales tin-plate trade seem to have arisen from the working of the International Tin-plate Agreement. The Welsh makers, having considerably exceeded their allotment, have had to relinquish certain markets for the time being to Germany, France, and Italy, in order to enable the tin-plate makers in those countries to fill their quotas.

Current Business.

The goodwill, plant, and buildings of Ramage and Ferguson, Ltd., shipbuilders, of Leith, have been purchased by Henry Robb, Ltd., shipbuilders, who own the adjoining yard. Orders for two locomotives have been placed by the Parana Plantations, Ltd., Brazil, with W. G. Bagnall, Ltd., of Stafford. Materials for the renewal and extension of tramway contracts totalling about 25,000 tons have been ordered by the Sheffield Corporation Transport Department. Most of the orders went to Middlesbrough works. The Portuguese Government has ordered six "Blackburn" seaplanes to a total value of £60,000. The London and North-Eastern Railway Company has placed orders for new carriages with R. Y. Pickering and Co., Ltd. The Dalmarnock power station of the Glasgow Corporation is to be refitted with new boilers and generating plant. The Department of Overseas Trade announces that the following contracts are open for tender:—Lithuanian Railway Administration: 10,000 kilos. of Babbitt's metal (February 20th, Lithuania). South African Railways and Harbours: Mild steel plates to specifications C.M.E. 9/1930, symbol No. 8, being the requirements for the period from July, 1935, to June, 1936 (Johannesburg, March 18th); one 85ft. electrically driven turntable (March 4th). Egypt, Ministry of Public Works, Tanzim Department: Overhead travelling crane of 5 tons capacity (Cairo, March 11th); workshop machines, including a hand hoisting crab, punching, and shearing machines, bench tool grinding machine, portable electric drilling machine, portable electric grinding machine for Belqas power station workshop, (Cairo, March 6th); 42 tons of mild steel plates, and 22 tons of mild steel angles for Government workshops (Cairo, March 2nd). Argentine State Railways: Six vertical turret lathes (Buenos Aires, March 20th). Persia, Consortium Kampsax of Tehran: 50 to 110 metal culverts of 6 m. span (Persia, March 3rd).

The Copper Position.

The copper market, like other departments of the non-ferrous metal markets, has been under the shadow of the failure of a Metal Exchange firm concerned in the pepper speculation. Although it was known that this firm had an important bull account, it was believed that it had liquidated during the preceding few weeks something like 20,000 tons of copper, and it came as a surprise that it is still "long" of about 7000 tons. The leading interests in the Metal Exchange, however, had taken steps to safeguard the situation. The Committee of the London Metal Exchange fixed special settlement prices for the firm's outstanding contracts, which, in addition to copper, included tin, lead, and spelter. Now that the position has been cleared, so far as the metal market is concerned, there seems a likelihood of confidence reviving. The market still has difficulties to contend with, not the least important being the uncertainty with regard to the American Gold Clause, which must be exercising a considerable influence upon progress in the negotiations which are being conducted between the world's copper producers for a restriction of output. It was not surprising that at the end of last week the price of electrolytic copper was distinctly weak, but after the worst of the position in the market was disclosed, values developed a tendency to advance. In the standard copper market the after effects of the recent heavy liquidation are likely to be felt for some time. Dealers appear to have filled their requirements and are less inclined to accept offerings, so that the quotation, although having a firmer tone, has been somewhat irregular.

The Tin Market.

The effect of the pepper crisis and the failure of a Metal Exchange firm which held commitments involving 1425 tons of tin, has naturally created an atmosphere of caution in this market. The Committee of the London Metal Exchange promptly announced special settlement prices for the firm's contracts and the leading interests made arrangements to meet the situation, so that the effects upon the market were not serious. Prices naturally showed a slightly easier tendency for a time. The three months' price which had been firmly held receded at the beginning of this week, and this reduced the backwardation. The market has become somewhat restive at the rigid control which is exercised, and it is pointed out that the Buffer Pool, of which so much was heard a little while ago, was expressly formed to relieve the market from a scarcity of metal. It is generally thought that this Pool should have been brought into operation some weeks ago, so that the squeeze which brought about a backwardation of £5 might have been avoided. One result, however, has been to bring stocks to London, and this contributed towards effecting a reduction in the three months' price. Disappointment is felt that consumption in the United States does not improve more rapidly. Lately, however, the consuming trades have shown more interest in the tin market, and when the uncertainty regarding the gold dollar is removed, they will probably buy on a more extensive scale.

Lead.

The lead market has been less affected than others by the circumstances arising from the failure of a Metal Exchange firm which was involved in the speculation in the pepper market. It seems that amongst the firm's commitments were contracts for about 1900 tons of lead, but steps were taken by strong interests on the Metal Exchange to take care of the position, and prices only fluctuated within narrow limits. Once the situation had been disclosed, the market showed a distinctly firmer tendency. It is possible that the trouble had been discounted beforehand, but the general view seems to be that lead prices have been at such a low level for so long that there was little room for a further fall. Statistically, the world position of the metal seems to be improving, although in America there are few signs of an expansion in the demand for lead. In this country the call from consumers, although not so heavy as a few months ago, has been well maintained. The lead pipe and sheet makers continue to take considerable quantities, and there seems to be a slight improvement in the Continental trade. Figures issued by the American Bureau of Metal Statistics indicate that there was an increase in the consumption of the metal during 1934 compared with the previous year, but that the stocks increased during the year by about 30,000 tons, amounting at the end of 1934 to 235,450 tons.

Spelter.

Apathetic conditions have ruled in the spelter market for a long time, and even the recent disturbances in the commodity markets has failed to arouse it from this state. Prices have developed a slightly firmer tone, but there seems little likelihood of any persistent advance in values until the Import Duties Advisory Committee has announced the result of its inquiry into the operation of the 10 per cent. duty. The demand from consumers in this country is on a fairly good scale, but naturally enough there is some hesitation in taking a forward view of the market whilst the uncertainty regarding the duties remains. The interesting announcement is made that the Electrolytic Zinc Company of Australasia will put a new unit at its zinc plant at Risdon, Tasmania, into commission in March. This will increase the output of the plant from 54,000 tons to 70,000 tons per annum. It is suggested that this will help the position on the London market by increasing supplies of Empire spelter. In the meantime premiums of about 25s. have been asked for non-dutiable metal. Delays in the arrival of foreign spelter are reported, but it is known that consignments of Belgian and Polish metal will reach this country later in the month. American figures give the world's production of zinc in 1934 as 1,285,838 tons.

Current Prices for Metals and Fuels.

Makers' official home trade prices, per ton, delivered buyers' stations. Sections, joists and plates are subject to a rebate to home users purchasing only from associated British Steelmakers: joists, 22s. 6d.: plates and sections, 15s. Export orders of 250 tons and over may be subject to special quotations.

PIG IRON.

	Home. (*D/d Teesside Area*) £ s. d.	Export. £ s. d.
N.E. COAST—		
Hematite Mixed Nos.	3 8 6	3 2 0
No. 1	3 9 0	3 2 6
Cleveland—	(*D/d Teesside Area*)	
No. 1	3 10 0	3 4 0
No. 3 G.M.B.	3 7 6	3 1 6
No. 4 Forge	3 6 6	3 0 6
Basic (*Less 5/– rebate*)	3 7 6	—
MIDLANDS—		
Staffs.—	(*Delivered to Black Country Station*)	
North Staffs. Foundry	3 11 0	—
„ „ Forge	3 6 6	—
Basic (*Less 5/– rebate*)	3 12 6	—
Northampton—		
Foundry No. 3	3 7 6	—
Forge	3 2 6	—
Derbyshire—		
No. 3 Foundry	3 11 0	—
Forge	3 6 0	—
SCOTLAND—		
Hematite, f.o.t. furnaces	3 11 0	—
No. 1 Foundry, ditto	3 12 6	—
No. 3 Foundry, ditto	3 10 0	—
Basic, d/d (*Less 5/– rebate*)	3 7 6	—
N.W. COAST—		
Hematite Mixed Nos.	3 12 6 d/d Glasgow; 4 0 6 „ Sheffield; 4 5 6 „ Birmingham	

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
LANCS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
S. YORKS.—		
Crown Bars	9 12 6	—
Best Bars	10 2 6	—
MIDLANDS—		
Crown Bars	9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	7 5 0 to 7 15 0	—
SCOTLAND—		
Crown Bars	9 12 6	9 5 0
Best	10 2 6	9 15 0
N.E. COAST—		
Common Bars	9 12 6	8 15 0
Best Bars	10 2 6	9 15 0
Double Best Bars	10 12 6	10 0 0

STEEL.

LONDON AND THE SOUTH—	Home. £ s. d.	Export. £ s. d.
Angles	8 10 0	7 7 6
Tees	9 10 0	8 7 6
Joists	8 17 6	7 7 6
Channels	8 15 0	7 12 6
Rounds, 3in. and up	9 10 0	8 7 6
„ under 3in.	8 14 6	—
Flats, 5in. and under	8 14 6	7 2 6
Plates, ¾in. (basis)	9 0 0	7 15 0
„ ⅝in.	9 5 0	8 0 0
„ ½in.	9 10 0	8 5 0
„ ⅜in.	9 15 0	8 10 0
„ ¼in.	9 10 0	8 5 0
NORTH-EAST COAST—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Plates, ¾in.	8 15 0	7 15 0
„ ⅝in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅜in.	9 10 0	8 10 0
„ ¼in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 5 0	8 5 0
MIDLANDS, AND LEEDS AND DISTRICT—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅝in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅜in.	9 12 6	8 10 0
„ ¼in.	9 5 0	8 5 0
Boiler Plates, ¾in.	9 7 6 .. 7 15 0	8 5 0

STEEL (*continued*).

GLASGOW AND DISTRICT—	Home. £ s. d.	Export. £ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 6
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 15 0	7 15 0
„ ⅝in.	9 0 0	8 0 0
„ ½in.	9 5 0	8 5 0
„ ⅜in.	9 10 0	8 10 0
„ ¼in.	9 5 0	8 5 0
Boiler Plates	9 5 0	8 5 0
SOUTH WALES AREA—	£ s. d.	£ s. d.
Angles	8 7 6	7 7 6
Tees	9 7 6	8 7 6
Joists	8 15 0	7 7 0
Channels	8 12 6	7 12 6
Rounds, 3in. and up	9 7 6	8 7 6
„ under 3in.	8 12 0	7 10 0
Flats, 5in. and under	8 12 0	8 17 6
Plates, ¾in. (basis)	8 17 6	7 15 0
„ ⅝in.	9 2 6	8 0 0
„ ½in.	9 7 6	8 5 0
„ ⅜in.	9 12 6	8 10 0
„ ¼in.	9 10 0	8 5 0

IRELAND—	BELFAST. £ s. d.	REST OF IRELAND. £ s. d.
Angles	8 12 6	8 15 0
Tees	9 12 6	9 15 0
Joists	9 0 0	9 2 6
Channels	8 17 6	9 0 0
Rounds, 3in. and up	9 12 6	9 15 0
„ under 3in.	9 2 0	9 4 6
Plates, ¾in. (basis)	9 0 0	9 2 6
„ ⅝in.	9 5 0	9 7 6
„ ½in.	9 10 0	9 12 6
„ ⅜in.	9 15 0	9 17 6
„ ¼in.	9 12 6	9 15 0

OTHER STEEL MATERIALS.

Sheets.	Home. £ s. d.	Export. £ s. d.
10-G. to 13-G., f.o.r.	9 0 0	8 15 0
14-G. to 20-G., d/d	10 5 0	9 0 0
21-G. to 24-G., d/d	10 10 0	9 5 0
25-G. to 27-G., d/d	11 2 6	9 17 6

The above home trade prices are for 4-ton lots and over; 2-ton to 4-ton lots, 10s. per ton extra; and under 2-ton lots, 30s. per ton extra.

Galvanised Corrugated Sheets, Basis 24-G.

Home.	£ s. d.
4-ton lots and up	13 0 0
2-ton to 4-ton lots	13 7 6
Under 2 tons	15 0 0

Export: £16 12s. 6d., c.i.f. duty paid India.
„ £11 5s. 0d., f.o.b. other markets.
„ Scandinavian Markets free.

Tin-plates.

20 by 14 basis, f.o.b. Bristol Channel Ports, 18/2 to 19/2.

Tin-plate Bars, d/d South Wales Works, £5 7s. 6d.

Billets.	£ s. d.
Basic (0·33% to 0·41% C.)	6 12 6
„ Medium (0·42% to 0·60% C.)	7 2 6
„ Hard (0·61% to 0·85% C.)	7 12 6
„ „ (0·86% to 0·99% C.)	8 2 6
„ „ (1% C. and up)	8 12 6
Soft (up to 0·25% C.), 500 tons and up	5 10 0
100 tons	5 15 0
Rails, Heavy, 500-ton lots, f.o.t.	8 10 0
„ Light, f.o.t.	7 10 0

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	3/3 per lb.	
Ferro Tungsten	3/– per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 0 0	7/–
„ „ 6 p.c. to 8 p.c.	£21 12 6	7/–
„ „ 8 p.c. to 10 p.c.	£21 12 6	7/–
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£34 0 0	11/–
„ „ „ 1 p.c. carbon	£38 15 0	12/–
„ „ „ 0·70 p.c. carbon	£42 0 0	12/6
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/5 per lb.	
Ferro Manganese (loose)	£10 15 0 home	
„ Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/– p.u.	
„ „ 75 p.c.	£17 19 6 scale 6/– p.u.	
„ Vanadium	12/8 per lb.	
„ Molybdenum	4/6 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£200 to £205	
Ferro Cobalt	5/3d. per lb.	

NON-FERROUS METALS.

Official Prices, February 13th.

COPPER—		
Cash	£27 1 3 to £27 2 6	
Three months	£27 6 3 to £27 7 6	
Electrolytic	£30 0 0 to £30 10 0	
Best Selected Ingots, d/d Birmingham	£30 15 0	
Sheets, Hot Rolled	£58 0 0	
	Home.	Export.
Tubes, Solid Drawn (basis)	9½d.	9½d.
„ Brazed (basis)	9½d.	9½d.
BRASS—		
Ingots, 70/30, d/d Birmingham	£27 0 0 to £29 0 0	
	Home.	Export.
Tubes, Solid Drawn, 2/1 Alloy	8¾d.	8¾d.
„ Brazed	10¾d.	10¾d.
TIN—		
Cash	£229 5 0 to £229 10 0	
Three months	£225 5 0 to £225 10 0	
LEAD:	£10 3 9 to £10 7 6	
SPELTER:	£11 18 9 to £12 2 6	
Aluminium Ingots (British)	£100	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
f.o.b. Grangemouth)—Navigation Unscreened	13/– to 13/6
„ Glasgow—Ell	16/6
„ „ Splint	17/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	14/– to 14/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Prime Steam	14/–
Unscreened Navigation	12/6 to 13/–
LOTHIANS—	
(f.o.b. Leith)—Hartley Prime	14/3 to 14/6
Secondary Steam	13/3 to 13/6

ENGLAND.

YORKSHIRE, MANCHESTER—	
B.S.Y. Hard Steams	18/6 to 21/6
Furnace Coke	15/– to 17/6
NORTHUMBERLAND, NEWCASTLE—	
Blyth Best	14/3 to 14/9
„ Second	13/3
„ Best Small	10/6 to 11/–
Unscreened	12/6 to 13/6
DURHAM—	
Best Gas	14/8
Foundry Coke	18/6 to 22/6

SHEFFIELD—	Inland.	
Best Hand-picked Branch	24/– to 26/–	—
South Yorkshire Best	21/– to 23/–	—
South Yorkshire Seconds	17/6 to 19/–	—
Rough Slacks	8/– to 9/–	—
Nutty Slacks	7/– to 8/6	—

SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Admiralty Large	19/6
Seconds	19/– to 19/4½
Best Dry Large	18/9 to 19/3
Ordinaries	18/3 to 18/6
Best Bunker Smalls	13/6 to 14/–
Cargo Smalls	11/6 to 12/6
Dry Nuts	22/– to 26/–
Foundry Coke	24/– to 37/6
Furnace Coke	19/– to 21/6
Patent Fuel	21/–
SWANSEA—	
Anthracite Coals:	
Best Large	37/6 to 40/–
Machine-made Cobbles	41/– to 51/–
Nuts	40/– to 50/–
Beans	25/– to 30/–
Peas	19/– to 22/6
Rubbly Culm	11/6 to 12/–
Steam Coals:	
Large	18/– to 20/6

FUEL OIL.

Inland consumption; contracts in bulk.
Exclusive of Government tax of 1d. per gallon.

Ex Ocean Installation.	Per Gallon.
Furnace Oil (0·950 gravity)	3½d.
Diesel Oil	4d.

Manchester prices ½d. per gallon extra.

French Engineering Notes.

(From our own Correspondent in Paris.)

The Culminating Crisis.

THE steady increase of unemployment figures, the heavy fall in railway receipts, the serious contraction of national revenue, and other evidences of a continuous economic decline, reveal that nothing has yet come of the efforts made to stem the crisis, and that industry has so far derived no benefit from the public works that were intended to reduce unemployment and provide some activity to engineering shops. The Marquet plan of relief works has partially failed, because sufficient funds are unobtainable except at a high rate of interest, and the plan is being modified in a manner that, it is hoped, will make it workable, while the prospect of cheaper money under the new financial scheme provides expectation that something will be done at an early date. For the moment, the works have only absorbed 20,000 men, and it is affirmed that the number will be doubled in three months' time; but as this falls far short of the increase in unemployment figures, no one is inclined to take the public works relief programme seriously. Manufacturers have to do the best they can with a bad situation. The slump in prices through the off-loading of stocks is general, and while the decline of prices of metallurgical products is kept in check by the sales' organisations, there is, nevertheless, a "deflation" of values which may be stabilised at a somewhat higher level if producers succeed in getting down costs, mainly with relief from what they regard as excessive taxation. The immediate effect of this state of things is to divert attention to the absolute necessity of promoting foreign trade. The attention given to the annual banquet of the British Chamber of Commerce in Paris on Friday last, when Sir John Simon, Monsieur P. E. Flandin, and the French Minister of Commerce were the principal guests, revealed the change which is taking place in the attitude of industrial and commercial communities towards the trade future. The French responded to the British plea for closer commercial relations, and the way is being prepared for a resumption of trading facilities, but there are many obstacles to be overcome before a satisfactory agreement can be reached, though the atmosphere is now more favourable to a settlement than it has been for many years past.

Industrial Groups.

The precarious situation of the engineering industries renders it imperative to do something to prevent an aggravation of difficulties that are the more serious because there does not appear, at the moment, to be any means of escaping from them. The industry has been buoyed up with hopes of the crisis coming to an end, and those hopes have now given way to the conviction that manufacturers can only hold on for a recovery that must set in eventually, though the uncertainty as to how long they may have to wait leaves them with no alternative but to give close consideration to the plan of industrial grouping for an adjustment of production to the country's needs. The more that plan is discussed the more it is criticised, largely because it is feared that legislation rendering compulsory the adhesion of a minority to any scheme of restriction adopted by a majority of manufacturers may encroach dangerously upon the liberty of producers. The Government has given the assurance that its control over production will be of an advisory character, and that compulsion will only be resorted to when desired by a majority; but the fact of the State exercising powers of this kind is regarded as preparing the way for a possible strengthening of State interference in industrial matters. Manufacturers are particularly suspicious of any attempt of the State to extend its influence over industry. There is further criticism to the effect that the methods proposed of limiting production to requirements may tend to create a closed ring in each branch of industry, whereby a majority of producers may eliminate smaller firms and utilise State control in their own interests. Much of this criticism comes from commercial organisations, which obviously fear that State control will tend to deprive industry of its competitive character; but, on the other hand, the Government has affirmed that its only object is to enable each branch of industry to carry on its own organisation according to the desires of a majority, and that it will be equally careful to look after the interests of consumers. Inspectors are to be appointed to investigate the conditions of production and consumption in various districts, so that the Ministry will be able to offer suggestions to producers for an adjustment of output. Meanwhile, the grouping of producers and consumers is being extended, and all the engineering firms in the northern Departments, numbering more than fifty, have constituted a "Groupement des Constructeurs et Industriels Consommateurs de Produits Métallurgiques" with a view to providing solutions of commercial, industrial, and technical problems affecting their industries.

Engineers' Degrees.

The proposals to render access to the engineering profession more difficult continues to be debated in a manner suggesting that something may be done eventually to remedy the shortcomings of the law controlling engineers' degrees. A conference on "What to do with Our 50,000 Engineers" was held last week under the auspices of the French Quality Committee. Monsieur Dautry, General Manager of the State Railways, affirmed that the number of students in the high technical schools had only slightly increased and that the crowding of the profession was to be attributed to the "mass production" of engineers at private schools, where too great a facility was provided for obtaining degrees. Monsieur Dautry was of the opinion that the only way to ensure a selection of good engineers was to deprive students of their right, on leaving schools, to use their diplomas until they had passed a certain period in industrial enterprises and shown that they were capable of applying their science, and that, in addition, they possessed the necessary moral qualities to control men. By that means, qualified engineers would be separated from works managers and technicians.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

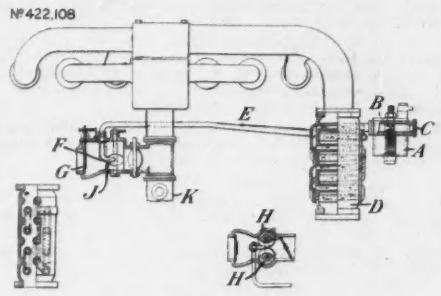
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

422,108. July 20th, 1934.—VAPORISERS, *R. Arnold*, 6, *Pembridge-place, London, W.2.*

This is a vaporiser for engines working with heavy oil fuel, which is heated by the exhaust gases. The oil is sucked up from the float chamber A into the choke tube B, where it is atomised by the injector action of a small quantity of air entering by the fine hole C. The atomised oil is then vaporised by the heat of the exhaust gases in the vaporiser D. It is conveyed by

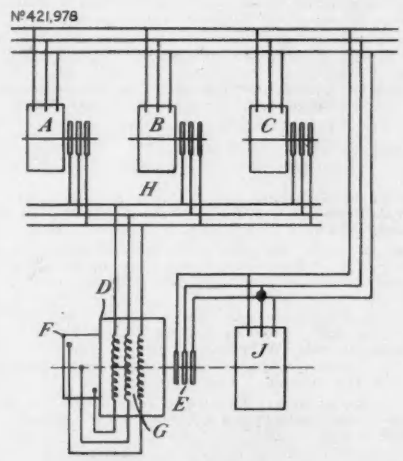


the pipe E to the jet F, where it is mixed with the air necessary for combustion admitted through the clack valve G. The jet F is arranged between two cylinders H H, which have recesses J cut in them. By rotating these cylinders the area of the passage can be varied. The construction of the vaporiser is shown in the cross section. For starting purposes a petrol carburetter is connected up to the branch K.—*January 4th*, 1935.

DYNAMOS AND MOTORS.

421,978. June 29th, 1933.—SYNCHRONISED INDUCTION MOTOR CONTROL, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C.2, and Bernard Adkins, of 13, Fisher-avenue, Paddox, Rugby.

For many purposes, such, for example, as the driving of sectional printing presses and other drives, it is required to run two or more mechanically independent induction motors in synchronism with each other. The invention provides a method of holding induction motors in synchronism over a range of speeds up to synchronous speed or above, and down to standstill or in the reverse direction if required. A, B, and C are induction motors with their stators connected to the alternating-current supply. The rotors are connected in parallel by means

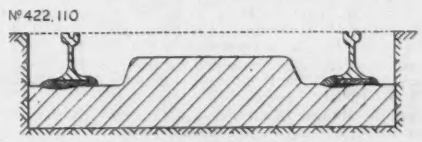


of the leads H and joined to the commutator frequency changer D. The primary winding on the rotor of the frequency changer is connected through slip rings E to the supply. The commutator F is connected in series with the stator winding G to the leads H. If the machines are suitably designed, the speed of the synchronised induction motors will then be exactly the same as that of the frequency changer, which may be driven in any manner according to the speed characteristics desired—for instance, by the motor J—which will be a variable speed machine. If it is desired to run up synchronously from rest to a fixed speed, J will be a self-starting synchronous motor with suitable gearing.—*December 31st*, 1934.

TRAMWAYS AND RAILWAYS.

422,110. September 1st, 1934.—PERMANENT WAY, Societa Italiana Pirelli, Via Fabio Filzi 21, Milan, Italy.

The inventors propose to reduce the vibrations from tramway

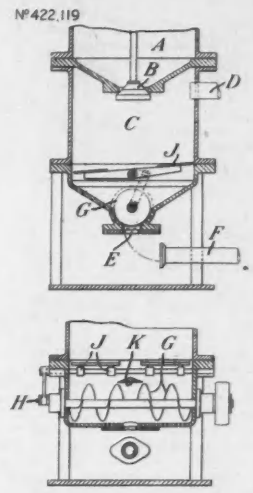


tracks by placing strips of rubber from 10 mm. to 12 mm. thick between the rails and the concrete foundation. The strips are secured to the rails by means of an adheaive such as cumarone, colophony, or copal, and the operation may be done on the site. The rails are packed up temporarily to the correct height by wooden wedges and grouted in. The rest of the cavity is then filled in to the level of the road surface.—*January 4th*, 1935

MACHINE TOOLS AND SHOP APPLIANCES.

422,119. June 6th, 1933.—SAND BLASTING MACHINES, J. W. Jackman and Co., Ltd., Vulcan Works, Blackfriars-road, Salford; and F. W. Neville.

The sanding material, which may be a mixture of sand and powder, is fed from the hopper A through the valve B into the box C. This box is supplied with air under pressure by the

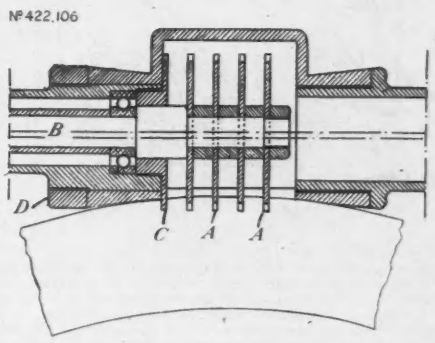


branch D. The outlet for the air and sand is shown at E, which communicates with the supply pipe F. In the base of the box there is a double-handed worm G, which moves the sand to the outlet. On the end of the shaft of this worm there is a crank H and a connecting-rod which rocks the trays J J and thus mixes the sand. The bar K prevents sand from falling straight through the box to the outlet.—*January 7th*, 1935.

MOTOR CARS AND ROAD TRAFFIC.

422,106. June 27th, 1934.—TOOLS FOR ROUGHING THE SURFACE OF PNEUMATIC TIRES, P. Koster and Société Parisienne d'Outillage Eléctrique, 42, Quai de Passy, Paris.

Pneumatic tires, the treads of which have been worn to such an extent that the non-skid pattern has disappeared, are rejuvenated by having transverse slits or grooves cut through the

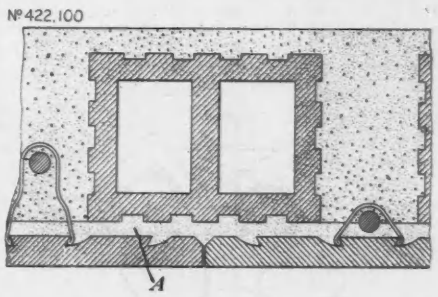


remaining rubber. The grooves are cut by saws A A on the spindle B, which is driven by any convenient means. The plain flange C is used to space the grooves from one of those already cut. The spindle is mounted excentrically in the handle D, so that the depth of the cut of the saws can be adjusted.—*January 4th*, 1935.

BUILDING.

422,100. May 8th, 1934.—CLIPS FOR SUPPORTING SLABS OR TILES IN BUILDING STRUCTURES, Rainford Potteries, Ltd., Rainford, Lancaster; F. W. Grundy and R. Southwick, Grammar School-lane Works, Halesowen, Worcestershire.

This invention relates to a clip for use in the support of slabs, tiles, or the like in building structures. It consists of a strip of



springy material bent upon itself in the form of an open bow to form two arms with inwardly turned ends which, when in position in engagement with grooves in the rear faces of the slabs or tiles in order to support the latter, exert a resilient pressure towards each other. After the structure has been completed cement A is poured into the interstices to hold the clips in engagement.—*January 4th*, 1935.

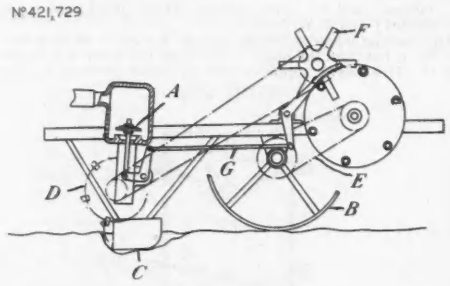
MISCELLANEOUS.

421,729. June 28th, 1933.—AGRICULTURAL PLANTING MACHINES, Transplanters (Holding Company), Ltd., 41, Moorfields, London, E.C.2, and I. Pomieraniec, 64, Wentworth-road, London, N.W.11.

When vegetable plants are set in the ground mechanically

it is desirable that each plant should receive a modicum of water as it is planted. This desideratum is effected in the mechanism shown by the valve A. The whole machine runs on wheels, one of which is shown at B, and the ground is opened up by the plough C. The plants are put in place by the rotary

Nº421,729



mechanism D, which is driven intermittently by the gearing E and the star wheel F. At the same time that the planting mechanism is rotated, the valve A is opened by the linkage G, so that a supply of water is given to the plant.—*December 28th*, 1934.

421,852. November 6th, 1933.—ELECTRIC FUSES, The General Electric Company, Ltd., of Magnet House, Kingsway, London, W.C.2; and William Wilson and John Walter Gibson, both of The General Electric Company, Ltd., Engineering Works, Witton, Birmingham.

The fuse described in this specification forms part of a switch fuse and includes a tube A of insulating material having end pieces or terminals B provided with switch contacts C. The fuse which constitutes the bridge piece of an oil switch is movably supported through the end pieces. The tube which, may be of porcelain, is barrel-like in shape and is provided with two diametrically opposite longitudinal slits D extending approximately over that part occupied by the fuse element. The latter includes a relatively thin wire or wires E enclosed in a body F of cork or other suitable material and having terminals G that pass through nozzle-shaped openings in pistons H, which are of suitable insulating material. The wire or wires may be composed of more than one metal or alloy. A bolt J passes diametrically through each piston and through a hole in a fuse terminal which is bolted to an intermediate member K. Each intermediate member is

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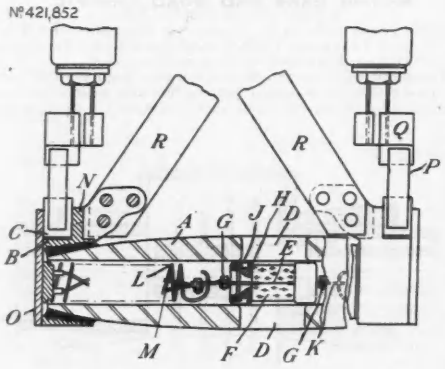

engaged by a normally tensioned spiral spring L, the outer end being secured to an end piece or terminal B. Flexible conductors M are clamped to the intermediate members K and are electrically connected with the terminals B, shaped as a ring having a sidewardly extending projection N and a removable end cover O. A part of the projection is formed with flats with which the spring fingers P of a stationary contact Q engage. The two links R form part of a suitable operating mechanism for raising and lowering the fuse end and thereby closing and opening the switch. The fixed contacts Q are supported in the usual manner on the cover of the switch tank, which is, of course, oil or fluid filled. Provision is made for lowering the latter for the purpose of exposing the switch contacts and the fuse. In the event of blowing of the fuse element E the springs L rapidly retract the pistons H from one another so that jets of liquid are forced past the fuse terminals and into the arcing space. The products of arcing escaping transversely through the slits D in the tube tend to blow out the arc.—*January 1st*, 1935.

422,008. October 27th, 1933.—ELECTRIC COUPLINGS, Siemens Brothers and Co., Ltd., of Caxton House, Tothill-street, Westminster, London, S.W.1; and Charles Lambert, of 16, Bramley-crescent, Ilford.

This invention has in view improved cable coupling arrangements of the clamping type and one in which the same clamping part serves for different sizes of conductors. According to

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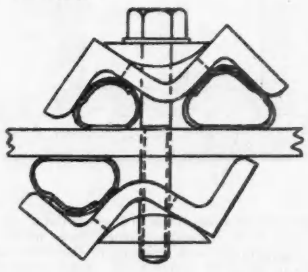

the main feature of the invention the end or the part of the conductor which is to be clamped to the terminal or intermediate part is provided with a sheath or wrapping easily applied and is embraced by a clamping member so shaped that on compressing the cable the latter is made to conform over a part of its periphery to the surface of the terminal or intermediate part and its strands are pressed into close contact with one another and with the sheath or wrapping.—*January 3rd*, 1935.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Savoy-place, W.C.2. "Domestic Water Heating," Mr. R. E. McInnes. 6.30 for 7 p.m.

INST. OF ELECTRICAL ENGINEERS: N. EASTERN CENTRE STUDENTS.—Armstrong College, Newcastle-upon-Tyne. The Students' Lecture, "Development in the Materials of Construction of Electrical Plant and Apparatus—Magnetic, Insulating, Conducting, and Mechanical," Mr. A. P. M. Fleming. 7.15 p.m.

INST. OF STRUCTURAL ENGINEERS: MIDLAND COUNTIES BRANCH. James Watt Memorial Inst., Birmingham. "Recent Developments in Self-indicating Testing Machines," Mr. A. H. Hancock. 6.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Lecture, "The Application of Proof Stress to Modern Aircraft Material," Mr. H. J. Alpe. 7.30 p.m.

PHYSICAL SOC.—At Imperial College of Science and Technology, South Kensington, S.W.1. Editing Committee meeting 3.30 p.m.; Council meeting, 4 p.m.; meeting, 4.45 for 5 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse by Prof. W. G. Constable. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INST.—Royal Technical College, Glasgow. "Heat Transmission in Some Types of Steam Boilers," Mr. P. St. G. Kirke. 7.15 p.m.

SATURDAY, FEB. 16TH.

INST. OF BRITISH FOUNDRYMEN: LANCASHIRE BRANCH.—Engineers' Club, Manchester. "Castings," Messrs. W. Machin and M. Oldham. 2.45 p.m.

INST. OF STRUCTURAL ENGINEERS: WESTERN COUNTIES BRANCH.—Royal Hotel, Bristol. Annual branch dinner.

MONDAY, FEB. 18TH.

INST. OF CIVIL ENGINEERS: YORKSHIRE ASSOC.—Visit to new works at Hope of G. and T. Earle, Ltd. Leave by motor coach from Midland Station, Sheffield, 11 a.m.

INST. OF METALS.—Joint Meeting with Inst. of Automobile Engineers, at 39, Elmbank-crescent, Glasgow. "Recent Advances in Metallurgy," Dr. A. McCance. 7.30 p.m.

MONDAY, FEB. 18TH, TO FRIDAY, MARCH 1ST.

BRITISH INDUSTRIES FAIR, 1935.—London Section. Daily.

TUESDAY, FEB. 19TH.

FARADAY HOUSE OLD STUDENTS' ASSOC.—Wharncliffe Rooms, Hotel Great Central, N.W.1. Annual dance. 8 p.m. to 2 a.m.

ILLUMINATING ENGINEERING SOC.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "Time Characteristics of Tungsten Filament Lamps for Flashing Signals, Signs, and Beacons," Messrs. J. M. Waldram and J. M. Sandford. 7 p.m.

INST. OF CIVIL ENGINEERS.—Great George-street, S.W.1. Discussion, "Speed in Relation to Curvature, with Special Reference to Road Curves," Prof. F. G. Royal-Dawson; "Aspects of Highway Curve Design," Mr. H. Criswell. 6 p.m.

INST. OF ELECTRICAL ENGINEERS: N. MIDLAND CENTRE.—Hotel Metropole, Leeds. "The Removal of Smoke and Acid Constituents from Flue Gases by a Non-effluent Water Process," Dr. J. L. Pearson, Messrs. G. Noneebel, and P. H. N. Ulander. 7 p.m.

INST. OF SANITARY ENGINEERS.—Caxton Hall, Westminster, S.W.1. "Effluents," Mr. A. Sciver. 6 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1.—"Benjamin Thompson, Count Rumford," by Sir William Bragg. 5.15 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Inclusions in Steel," Dr. W. R. Maddocks. 7.30 p.m.

WEDNESDAY, FEB. 20TH.

CHARTERED SURVEYORS' INST.—12, Gt. George-street, S.W.1. "The Royal Palace of Whitehall," Mr. T. W. Lovell. 8 p.m.

ENGINEERS' STUDY GROUP ON ECONOMICS.—Denison Hall. Vauxhall Bridge-road, S.W.1. "Planned Money," Sir Basil Blackett. 7.45 for 8 p.m.

INST. OF CIVIL ENGINEERS: STUDENTS.—Great George-street, S.W.1. "Design and Construction of the Reinforced Concrete Centres and Retaining Walls at Messrs. Stewarts and Lloyds' Steel Works at Corby," Mr. Geoffrey Wood. 6.30 p.m.

ROYAL METEOROLOGICAL SOC.—49, Cromwell-road, S. Kensington, S.W.7. Meeting, 4.30 for 5 p.m. Hotel Vandyke, 53, Cromwell-road, S.W.7; dinner, 7 p.m.

ROYAL MICROSCOPICAL SOC.—B.M.A. House, Tavistock-square, W.C.1. Meeting. 5 for 5.30 p.m.

ROYAL SOC. OF ARTS.—John-street, Adelphi, W.C.2. "Water Supplies from Underground Sources," Lieut.-Colonel J. D. Restler. 8 p.m.

SOC. OF GLASS TECHNOLOGY.—In Applied Science Dept., The University, Sheffield. Discussion, "The Analysis of Glass by the Treatment of Thin Film in the Autoclave," Mr. A. R. Wood; "The Influence of some Batch Constituents in the Colour of Glass," Mr. E. J. C. Bowmaker; "An Investigation of Selenium Decolourising," Dr. E. J. Gooding and Mr. J. B. Murgatroyd. 2 p.m.

THURSDAY, FEB. 21ST.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOC.—Visit to works of Belliss and Morcom, Ltd. 2.30 p.m.

INST. OF STRUCTURAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. "Earthquake Resistance of Structure," Mr. C. W. Hamann. 7 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS: TEESSIDE BRANCH.—In the Cleveland Scientific and Technical Inst., Corporation-road, Middlesbrough. "Heavy Weather Damage," Mr. J. Foster King. 7.30 p.m.

FRIDAY, FEB. 22ND.

INST. OF CHEMICAL ENGINEERS.—Hotel Victoria, Northumberland-avenue, W.C.2. Annual general meeting, 11 a.m.; Presidential Address, "Chemical Engineering in Explosives Manufacture," Mr. W. Macnab, 11.45 a.m.; luncheon, 12.45 p.m.; "The Historical Development of Distilling Plant," Dr. A. J. V. Underwood, 2.15 p.m.; annual dinner, 7 for 7.30 p.m.

INST. OF FUEL: EAST MIDLAND SECTION.—Derby Technical College, Derby. "The Evaluation of Coal for Steam Raising," Dr. E. S. Grunell. 7 p.m.

INST. OF MARINE ENGINEERS.—Connaught Rooms, Great Queen-street, W.C.2. Annual dinner. 7 p.m.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Annual general meeting. Discussion, "Worm Gear Performance," Dr. H. E. Merritt. 5.30 p.m.

INST. OF PROFESSIONAL CIVIL SERVANTS.—At Royal Soc. of Arts, John-street, Adelphi, W.C.2. "The Cathode Ray Oscillograph," Mr. R. A. Watson. 5 for 5.30 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. "The Repair of Small Boilers and Pressure Vessels," Mr. F. A. Glidewell. 7.30 p.m.

NORTH-EAST COAST INST. OF ENGINEERS AND SHIPBUILDERS.—At Mining Inst., Newcastle-on-Tyne. "Ship Vibration: Simple Methods of Estimating Critical Frequencies," Mr. L. C. Burrill. 6 p.m.

RAILWAY CLUB.—At Royal Scottish Corporation, Fetter-lane, E.C.4. Annual general meeting, Presidential Address, "Eastern Counties Railway." 7.15 p.m.

ROYAL INST. OF GREAT BRITAIN.—21, Albemarle-street, W.1. Discourse, "Some Experiments in Gravitation and Magnetism," Prof. A. O. Rankine. 9 p.m.

SATURDAY, FEB. 23RD.

INST. OF CIVIL ENGINEERS.—Students' afternoon visit to works of Metropolitan Water Board at Stoke Newington, N.

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Visit to Barking power Station. 3 p.m.

STEPHENSON LOCOMOTIVE SOC.: MIDLANDS.—At 4, Bury Old-road, Manchester. "The Railways of Norway and Greece," Mr. S. H. Beaver. 6.30 p.m.

MONDAY, FEB. 25TH.

INST. OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, S.W.1. "Some Aspects of Workshop Costing," Mr. S. W. Lister. 6.45 p.m.

TUESDAY, FEB. 26TH.

INST. OF ELECTRICAL ENGINEERS: SCOTTISH CENTRE.—North British Station Hotel, Edinburgh. "Electrical Control of Road Traffic by Vehicle Actuation," Mr. T. P. Preist. 7 p.m.

INST. OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow, C.2. "Reinforced Concrete as a Structural Material," Dr. O. Faber. 7.30 p.m.

INST. OF FUEL: NORTH-WESTERN SEC.—Engineers' Club, Manchester. General discussion, "Steam Costing." 7 p.m.

SHEFFIELD METALLURGICAL ASSOC.—198, West-street, Sheffield. "Surface Conditions of Files," Mr. A. G. MacDougall. 7.30 p.m.

WEDNESDAY, FEB. 27TH.

INST. OF AUTOMOBILE ENGINEERS.—Engineers' Club, Manchester. "Piston Temperatures on a High-speed, Air-cooled Petrol Engine," Mr. H. Wright Baker. 7 p.m.

INST. OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOC.—Annual Students' meeting. St. Edmund's Restaurant, Edmund-street, Birmingham. Supper, 6.45 p.m. Discussion, "The Influence of Road Construction on Accidents."

INST. OF ELECTRICAL ENGINEERS: LONDON STUDENTS.—Florence Restaurant, 53, Rupert-street, W.1. Twenty-eighth annual dinner. 7.15 for 7.30 p.m.

INST. OF FUEL.—At Chemical Soc., Burlington House, W.1. "Boiler Practice in H.M. Office of Works, with Special Reference to the Use of Blended Coals," Mr. A. G. Pallot. 6 p.m.

INST. OF STRUCTURAL ENGINEERS: SCOTTISH BRANCH.—129, Bath-street, Glasgow. "Structural Uses of Aluminium and its Alloys," Mr. E. T. Painton. 7.15 p.m.

LIVERPOOL ENGINEERING SOC.—9, The Temple, 24, Dale-street, Liverpool. Joint meeting with Inst. of Electrical Engineers, Mersey and N. Wales (Liverpool) Centre. "Automatic Street Traffic Signalling," Mr. T. P. Preist. 6.30 p.m.

THURSDAY, FEB. 28TH.

INST. OF AUTOMOBILE ENGINEERS.—Red Lion Hotel, Luton. "Small Racing Cars," Mr. H. N. Charles. 7.30 p.m.

INST. OF ELECTRICAL ENGINEERS: S. MIDLAND CENTRE.—In Hall of the Central Technical College, Suffolk-street, Birmingham. Faraday Lecture, "Electricity in the Life of To-day," Professor E. W. Marchant. 6.30 for 7 p.m.

INST. OF METALS.—James Watt Memorial Inst., Birmingham. "The Rarer Metals—Gold, Silver, and Platinum," arranged by Johnson Matthey and Co., Ltd. 7 p.m.

INST. OF STRUCTURAL ENGINEERS.—10, Upper Belgrave-street, S.W.1. "Vibration and Pervibration in Concrete Depositing," Mr. T. J. Gueritte. 6.30 p.m.

FRIDAY, MARCH 1ST.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Informal meeting. Lecture, "Random Notes on Engineering in Greece," Mr. Leslie Turner. 7.30 p.m.

MANCHESTER ASSOC. OF ENGINEERS.—Manchester Limited Restaurant, Royal Exchange, Manchester. Annual dinner and dance. Reception, 7 p.m.; dinner, 7.30 p.m.; dancing, 9.30 p.m. to 1 a.m.

MONDAY, MARCH 4TH.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "The New Bridge over the Little Belt," Dr. Ing. e.h.o. Erlinghagen. 5.15 for 6 p.m.

ENGINEERS' GERMAN CIRCLE.—At Inst. of Mechanical Engineers, Storey's-gate, S.W.1. "The Velox Boiler and its Possibilities as Applied to Land and Sea," Herrn. Adolf Meyer. 5.15 for 6 p.m.

TUESDAY, MAR. 5TH.

INST. OF AUTOMOBILE ENGINEERS.—At Royal Geographical Soc., Kensington Gore, S.W.7. Joint meeting with eleven other technical societies. Symposium. "Cold Pressing and Drawing." Papers: (*a*) "From the Mechanical Point of View," Dr. H. Gough, F.R.S.; (*b*) "From the Metallurgical Point of View," Dr. C. H. Desch, F.R.S.; and it is hoped that Prof. Dr. Ing. G. Sachs will deal with some aspect of the subject. Prof. Sir Harold Carpenter, F.R.S., will take the chair at 7 p.m.

WEDNESDAY AND THURSDAY, MAR. 6TH AND 7TH.

INST. OF METALS.—Annual general meeting. For programme see February 8th, 1935, page 148

FRIDAY, MAR. 8TH.

INST. OF MECHANICAL ENGINEERS.—Storey's-gate, S.W.1. Prof. B. P. Haigh will introduce discussion on "Recent Work in Testing Steel of Mild and Moderate Tensile Strength." 7 p.m.

JUNIOR INST. OF ENGINEERS.—39, Victoria-street, S.W.1. Informal meeting. "The Construction of a Modern Liner," Mr. E. H. Brooks. 7.30 p.m.

LAUNCHES AND TRIAL TRIPS.

ROTULA, single-screw motor tanker; built by Netherland Shipbuilding Company, Ltd.; to the order of the Royal Shell Group; dimensions, 489ft. by 59ft. by 34ft.; to carry oil in bulk. Oil engines constructed by Werkspoor N.V., of Amsterdam. Launch, February 2nd.

BARON RENFREW, steel screw cargo steamer; built by D. and W. Henderson and Co., Ltd.; to the order of Messrs. H. Hogarth and Sons, Glasgow. Engines, triple-expansion; constructed by the builders. Launch, February 6th.

CALABAR, motor vessel; built by Harland and Wolff, Ltd., to the order of the Elder Dempster Line; dimensions, 256ft. 6in. by 41ft.; to carry passengers and cargo. Diesel engines, Harland-B. and W. type; constructed by the builders; launch, February 7th.